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Popular Mechanics

Written So You Can Understand It

Vol. 13 JANUARY No. 1

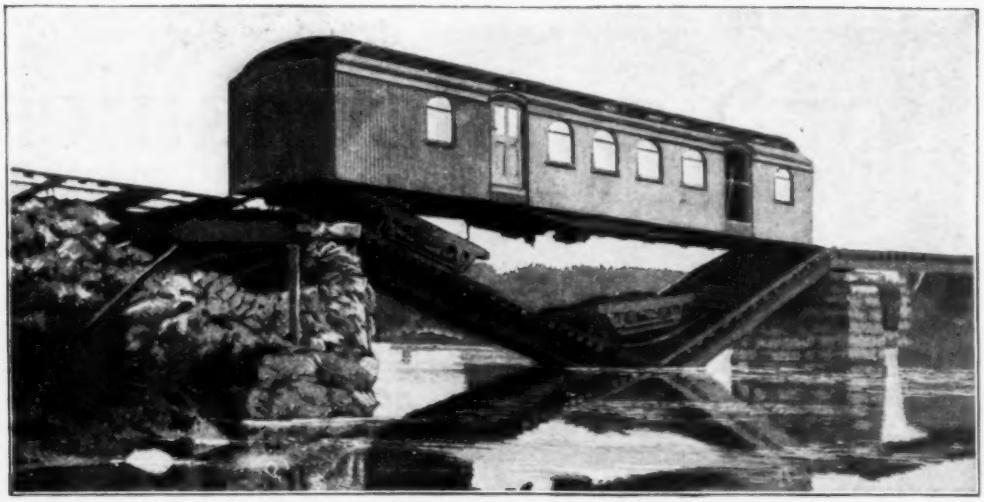
TWO EXTRAORDINARY RAILWAY BRIDGE ESCAPES

The railroad bridge accidents that recently occurred at Telluride, Colo., and Sumner, Iowa, are more than usually interesting because of the curious manner in which parts of the trains were left suspended, and the narrow escapes.

Narrow Escape of Train

In the first instance, the supports of the bridge had been carried away by a cloudburst. This the engineer did not know until almost upon it. He reversed his levers, turned on the air, and, accompanied by the fireman, jumped. The engine stopped as shown in the illustration, suspended by nothing more solid than the rails.

The bridge at Sumner collapsed as a train was passing over it. The engine had made the second span safely when the first span gave way, and the baggage car was just in the right position to land safely with its ends on the



Baggage Car Spans Bridge That Falls

piers, forming a new and somewhat extraordinary span. The forward trucks of the baggage car are shown in the center of the broken span.

COOKER USED BY POLAR EXPLORERS

An interesting article, which is as necessary in the equipment of a polar explorer as food, is the cooker. Without it, it would be impossible for life to exist in those regions. It is seen in its most primitive form in the Eskimo's blubber lamp.

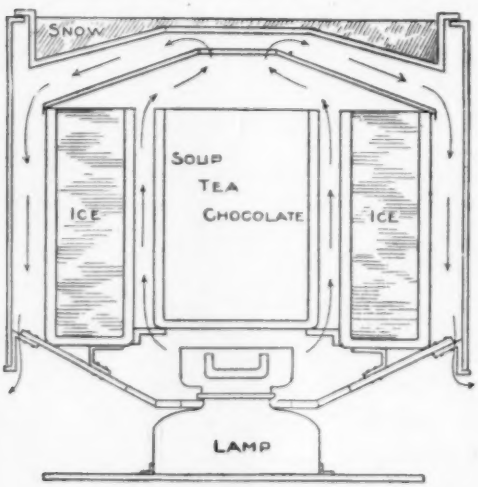


Diagram of Explorer's Stove

Many cookers were devised and experimented with by the different explorers. None was very successful owing to the fact that only about 50 per cent of the heat given off was put to any use. Alcohol, while it had high heat-giving properties, was in great danger of being rapidly evaporated by exposure to air. The various oils were all too heavy for the amount of heat given. However, mineral oil was successfully used as a substitute by Commander Peary on one of his earlier ice-cap journeys when his advance supply of alcohol was drifted over and lost.

The cooker shown in the sketch burns a special grade of petroleum and represents what is considered the latest type of cooker used by polar explorers. The whole thing is made of aluminum or sheet German silver and weighs, including the lamp, two mugs, two spoons, and one ladle, about 8½ lb. The whole thing is very compact; is easily taken apart and put together and is constructed so that the heat and flame are used to the very best advantage. The path of the heat is shown by the arrows. When packed the burner sits inside the central cooking pot. A strap around the outside holds it together. The cooker shown is constructed for

two men. Four gallons of the fuel mentioned, with care, will cook two hot meals a day for 120 days. The soup is being warmed in the central cooking dish while snow and ice are being melted in the outside dishes for the tea. When one of the courses is over, the other is about ready.

FISHING FOR PEARL NECKLACE

Diving for pearls in the oyster shell is an active business in all the pearl-bearing waters of the world, but diving for pearls in a necklace is a somewhat unique variation of the usual procedure. Some time ago Mrs. E. T. Earl, of Los Angeles, lost a $30,000 pearl necklace overboard while one of the Manning steamers was lying at the dock in Avalon harbor. A professional diver was offered a large reward for recovering the jewels and spent several days trying to find them, but his quest proved unsuccessful.

"NIAGARA" AND "AEROPLANE" HATS

The fact that year by year the new fads in women's hats are announced as the latest importations from Paris, has naturally given rise to the idea that anything new in this line must come

Aviation Hat for Women

from abroad, yet English magazines have recently drawn attention to these two hat importations from America to Europe.

A Waterfall of Plumage

One is the "aeroplane" hat and the other is designated as the "Niagara" hat. The former is announced as a creation from Chicago, worn by at least one person in England, and hourly expected on the continent. The latter receives its Niagara name because its arrangement of feathers gives it an appearance as seen from the rear of a waterfall.

TRINITY BELLS MODULATED

The famous chimes of Trinity church, New York, were recently overhauled and one of the 3,000-lb. bells is being recast to give a better tone. The most interesting feature of the rejuvenation, however, is the installation of a playing apparatus provided with loud and soft pedals. This effort to modulate the expression in chimes playing is said to be unique.

Hide of a Cheetah

BUSINESS CATALOGUES AS TEXT BOOKS

Many of the pupils in the public schools of Cuba are learning English by a studious application to the illustrated catalogues of American business firms. The idea was conceived by Miss Abbie Phillips, supervisor of English in the schools of Havana, and, according to Consul Henry P. Starett of Havana, the method of teaching may prove highly valuable in the sale of American products.

In following out the idea, Miss Phillips applied to a number of American business houses and was immediately supplied with catalogues.

PREPARING THE ROOSEVELT SKINS

Theodore Roosevelt's scientific companions in Africa, often spoken of as the "Roosevelt Pickling Corps," are highly praised at the Smithsonian Institute because of the expert manner in which the trophies of the hunt that have arrived in Washington were packed.

The skins were received in the barrels shown in the illustrations, and the unpacking was done to discover their condition and throw out any that might have shown the effects of the trip. In all the shipments up to the time this story was written, not a skin was found that had to be thrown out, nor had a single skin deteriorated. This is a wonderful record, according to experts, as it has seldom, if ever, happened that skins packed in the tropics have all come through in perfect shape.

The skins were packed in brine, and were again repacked as soon as possible after examination to be stored until the return of the great hunter. Some of the skins in the lot belong individually

A Zebra Hide Among the Roosevelt Trophies

to the members of the Roosevelt party, and none of the scientists in Washington know which is which.

Many of the skins are said to be the most magnificent ever received in this country, and this is specially true of the hippopotamus, rhinoceros, and cheetah skins. The giant rhinoceros skin is shown in one of the illustrations, and the hippopotamus skin is one of the largest and most perfect ever exhibited in the United States. Along with the

Half of Giant Rhinoceros Skin

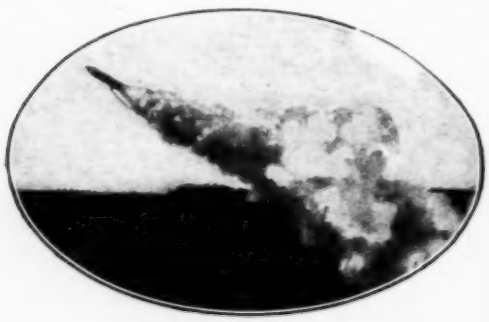
skins came a complete set of bones of the hippo, and several other of the animals to which the skins belong.

Room in Smithsonian Institute—Zebra Skins Being Treated—Barrels Are Full of Skins

AERIAL TORPEDO CARRIES LIFE-LINE

This aerial torpedo, invented by Col. Unge of the Swedish army and acquired by the German army, was devised as a projectile for saving instead of taking life, and in this respect, at least, greatly differs from the same inventor's aerial torpedo for the destruction of airships.

It is shaped like an ordinary gun shell, and propels itself in practically the same way as a skyrocket. It is



Life-Saving Aerial Torpedo

launched from a trough similar to the kind used in sending up skyrockets, but so arranged that it can be elevated or lowered to suit the requirements of the range-finder, and is propelled by a slow-burning powder, the discharge of gas from which drives it forward.

The life-line is attached to a collar somewhat similar to the kind worn by dogs. This is placed in position at the top of the trough. The propulsion charge is then ignited by an electric spark and the torpedo shoots forward on its flight. The nose of the torpedo slips through the collar, but a rim projecting from the back end catches it, and line and torpedo sail over the wrecked ship.

THE GAS ENGINE AS A FARMING INCENTIVE

That the gasoline engine may become an important factor in keeping the boys on the farm is the opinion expressed by a writer in the Gas Power magazine. He believes that there is no surer way of accomplishing this much desired result than such a means, and that the boy who does not take a keen interest in gas engines is sadly lacking in push and ambition.

"The boy who has a gas engine on the farm," says the writer, "will have his mind and time occupied. He will

begin to study new methods of making the engine do the work he ordinarily performed. Long hours and hard work discourage many farm boys and induce them to turn their eyes toward the cities, but when they can shell and grind the corn, saw the fire wood, operate the pump and milking machine, turn the grindstone, and accomplish countless other tasks by means of gas power, the call of the city will be lessened."

Some farmers may consider this desire of the boy to have an engine do his work a means of shirking, but such is hardly the case. It is but a natural desire of all who have ambition to lighten the work of the hands by the knowledge of the brain, and the boy who successfully operates a gas engine will be provided with a sufficiency of both brain and manual labor to keep him busy.

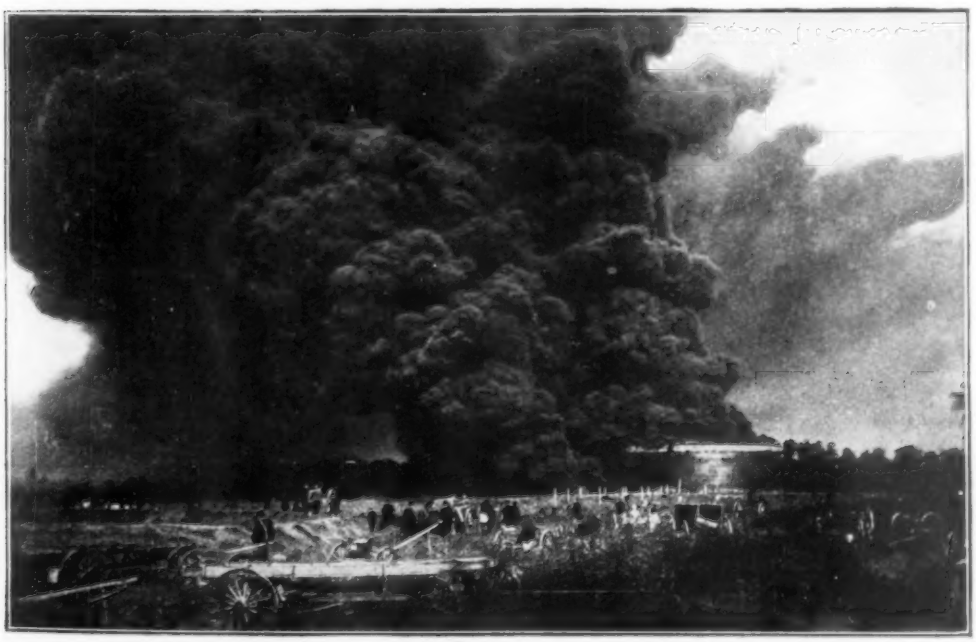
It is the hands continually busy and the brain continually dreaming that eventually drives the boy to the great centers.

CHINA FURNISHES IRON TO AMERICA

Although it is a fact not generally known, a considerable portion of the iron melted in the cupolas of the Pacific coast plants comes from Chinese furnaces, and in all probability the future will see an advance in the number of shipments of this metal. Much iron ore will also be drawn from Mexico and Cuba.

OIL WELL AND STORAGE TANK FIRES

The illustrations show two big oil and gas fires which occurred in Illinois last October. The burning gas and oil well, which is shown spouting flame and smoke, is located about four miles south of Lawrenceville. The gas ignited from fire under the boilers while the well was being drilled, and burned



Illinois Oil Well Fire Started by Lightning

for 24 hours before it could be capped. When the well gushed, which was

Burning Oil and Gas Well

every 20 minutes, the flame shot up 200 ft.

The other illustration shows an oil tank fire near Bridgeport. The tank, which had a 37,000-bbl. capacity, and cost $6,000, was struck by lightning on Oct. 20.

HIGH-SPEED JAPANESE MILITARY AEROPLANE

With characteristic secrecy the Japanese have been busily developing a military aeroplane at Hakodate, which is said to be a "world beater." While Glenn H. Curtiss was winning the Case International Cup with a speed of six miles in something less than nine minutes—since which Hubert Latham has made a mile a minute for seven minutes—the little brown men of the Far East have developed a bird-like craft that attained a speed of 68 miles an hour. This is the fastest time on record for aerial navigation. There has been no publicity to the Japanese trials. As in the case of the Wright trials at Fort Myer, there was a cordon of troops surrounding the flying field, but they were not there to preserve decorum on the part of a throng of spectators. They were there to eliminate spectators altogether.

CABOOSE THAT WENT "FURTHEST NORTH"

Whether Peary went further north than Cook or Cook as far north as Peary, and first, is still a vexing question, but this Erie railroad caboose undoubtedly went further north than any other railroad equipment.

When Peary was preparing for his expedition of 1898 he applied to the president of the Erie railroad for the superstructure of a short-pattern freight caboose for use as a temporary deck-house on his good ship "Windward." His request was granted, and the caboose, now an interesting relic in the glen at Shohola, Pa., went north to latitude 78. During the long winter

Caboose That Went to Latitude 78

night of 1899-1900 it formed the shelter for Commander Peary and two companions at Etah.

Prof. Winchell, of Minneapolis, believes the world is now shaped like a bartlett pear, instead of being round.

LONGEST AQUEDUCT IN THE WORLD

By Burt A. Heinly, Secretary to the Chief Engineer

Length of Imperial Rome's longest aqueduct	57 miles
Length of New York's Catskill aqueduct, now under construction	91 miles
Length of the Los Angeles aqueduct from the intake to the lower reservoir in the San Fernando valley—now under construction	240 miles

Los Angeles, in what is by far the longest aqueduct in the world, is building to give a domestic water supply to 2,000,000 people, irrigate 75,000 acres of land contiguous to the city and develop 60,000 hp. of electrical energy. With this three-fold purpose consummated, the city is of the belief that not only will there be an abundance of water without price for municipal use with the lighting of the city and the free use of electric power in the construction of the municipal harbor at San Pedro, but also from the revenues derived from the disposal of the water and power to individuals, corporations and smaller cities, that the project will in the course of years pay for itself and be a highly remunerative investment. Certainly no enterprise offers possibilities of larger financial returns, and as certainly at the outset no enterprise ever appeared more quixotic and impossible.

The many streams which flow down the eastern face of the great Sierra range are to be collected into a big conduit, passed from one huge reservoir to another, sent across more than 120 miles of absolute desert, shot under a mountain range, and finally impounded in two great storage basins 1,000 ft. above the city where the precious fluid will be drawn off as needed for the use of a thirsty land.

During the height of the bond campaign of 1907, when money was sought to defray the cost of the enterprise, it was confidently asserted that the odds were too great and that the project could never be carried through to completion, or, if so, instead of six years, the estimate made by the engineers in charge, it would require at least 30 years and $50,000,000 to make the plan realized.

At the present time there is being excavated a little over five and one-half miles of aqueduct per month, more than a mile per week—think of it—and the most difficult parts are being undertaken first in order to get them out of the way. At this rate, the big conduit will be completed well within the time estimate and, at the present cost, instead of asking for more money, there will be a substantial amount left in the treasury.

With the exception of 10 miles of easy construction let to a contractor, all the work is being done by the city with its own workmen and its own hydraulic engineers. The rapidity with which these forces are accomplishing their end is as remarkable as the project. Here again a comparison with the great New York Catskill aqueduct may prove helpful. New York will expend $162,000,000 on her aqueduct system and will receive a daily supply of 500,000,000 gallons. Los Angeles on the other hand will receive by her system of reservoirs, 250,000,000 gallons of water daily during the winter, or rainy season and more than 300,000,000 gallons per day during the five long dry months of the summer period, but the cost will be $24,500,000, or less than one-sixth of the amount that New York is required to expend.

Two hundred and fifty miles to the north of Los Angeles, beyond the Coast range of mountains and across the barren waste of the sand-blown Mojave desert is the Owens valley. It is to this valley that Los Angeles is going for its water supply. The valley lies in a narrow and deep cleft in the

earth with towering mountain ranges on each side. The eastern range composes the Inyo mountains upon which little rain ever falls, but the west range is the snow-capped Sierra, the roof-shed of the North American continent, many of whose peaks glisten white throughout the summer and whose snow banks and small glaciers, some of which have never been thoroughly explored, send down streams of purest quality throughout the year.

The Owens valley in itself receives little rainfall because the peaks of the Sierra rob the clouds of their moisture as they pass from the Pacific ocean eastward. The Owens river flows from north to south through the valley. This river has its headwaters in the Sierra, not far from the Yosemite Park, and by the time it reaches its outlet in Owens lake, it has received the drainage of 2,800 square miles.

Owens lake, 7 miles wide by 16 miles long with an average depth of 40 ft., is a body of water with no outlet. This lake lies just at the mouth of the Owens valley and is included in the extreme northern end of the Mojave desert. As a huge evaporating pan for the waters of Owens river, through countless ages this body of water has become so heavily impregnated with mineral salts as to outrival the Great Salt Lake in density.

In designing the plan of the aqueduct it was necessary therefore to carry the water around and above the lake in a conduit high on the bench of the mountain

range; also, to go far enough from the lake so that there would be no danger of receiving the lake's alkalinity through the aqueduct intake. After many months of investigation by U. S. Government and city chemists a point on the Owens river, 11 miles north of the town of Independence, in Inyo county, California, and 35 miles from Owens lake was found to be admirable for the purpose and here the intake stakes were set.

The valley is very thinly inhabited and the mountain watershed lies lonely in its solitude. Moreover much of the valley and all this part of the Sierra range lies within the Sierra forest reserve which, with the city's land purchases of more than 120 square miles, guards the city in perpetuity against any contamination of the water supply.

Composed of melting snows and glacial ice, the streams of the region are of great purity. In fact the water is of only half the hardness of the water the city is now using. The flow which will also be received from artesian wells along the first 20 miles of canal is of even greater softness than that coming from the mountain watershed.

Because of the fact that the city practically completed all of its purchases of land and water rights in the Owens valley secretly before the plans of the municipality were publicly known, thus avoiding the snares and pitfalls of hold-up speculators, and because of the sparseness of population, Los Angeles was able to buy both land and water at an extremely low figure. Land cost on an average of $14.50 per acre and all land and water rights including rights of way and reservoir sites were purchased for approximately $1,750,000. It is again interesting to compare this phase of the project with that of the Catskill aqueduct, where New York has been forced to purchase entire town sites, remove some 40 cemeteries with their 5,000 dead, divert railroad lines, etc., and all at tremendous expense.

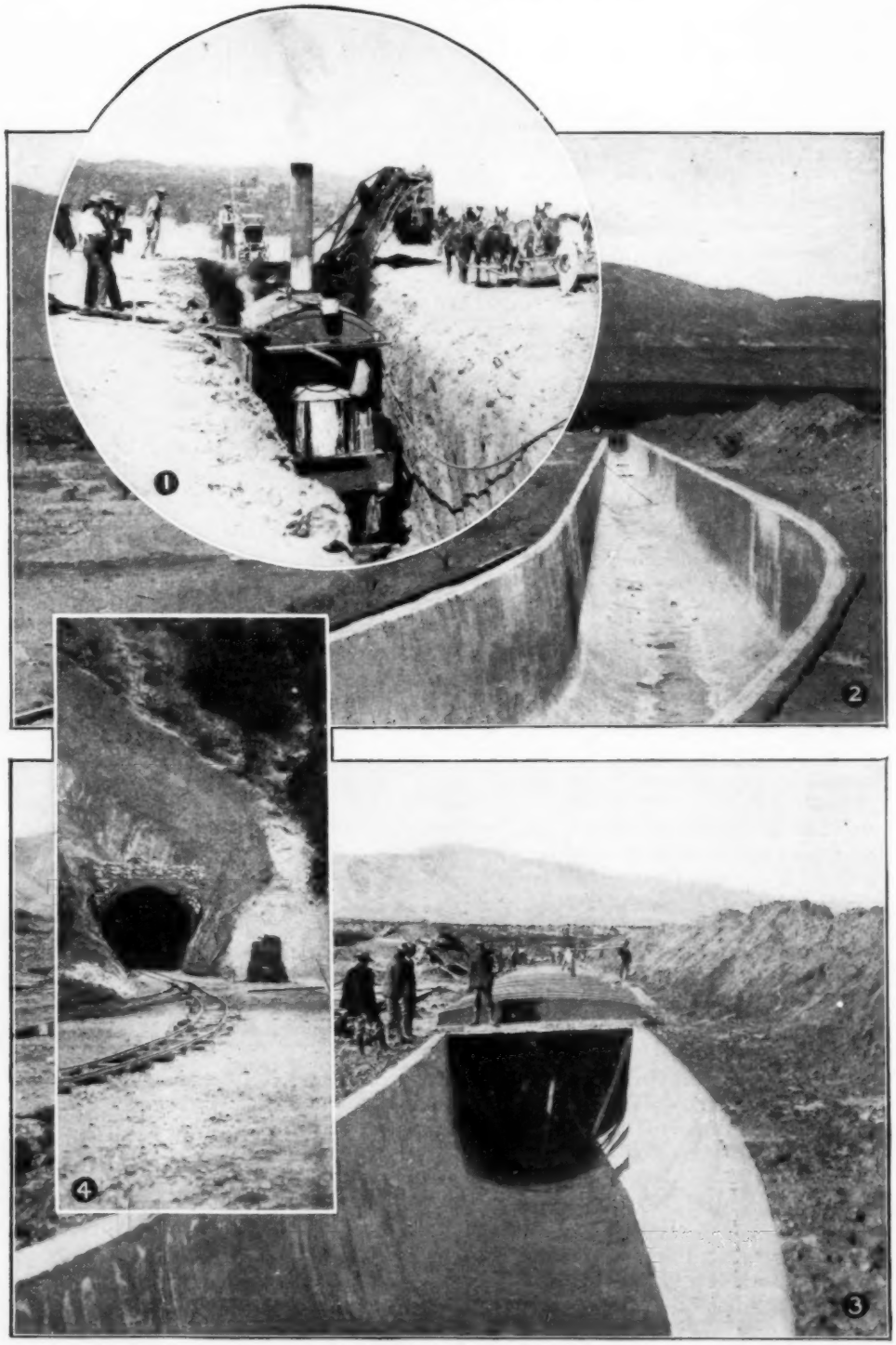
With a knowledge of the quality of the water and where it comes from, we are now ready to trace the devious course of the aqueduct and in simple terms to discuss the engineering stratagems by which Nature in this region, certainly to be found here in one of her sternest moods, is being circumvented for the profit of future generations.

Let us first learn the elevations because these compose the first information that the hydraulic engineer seeks to determine. That of the city varies greatly from sea level to the tops of the hill sections where it rises to 600 ft. The average, however, is 276 ft.

By two years of surveys in which some 1,800 miles of preliminary lines were run, a path was found by which the water could be conducted over a gentle grade all the way to the northern base of the Coast range of mountains. This range blocked all passage to the San Fernando valley, 65 miles distant, at the mouth of which Los Angeles is situated. The obstacle is being overcome by the construction of a tunnel 26,860 ft. long, so that on completion the water will be turned in at the intake, gather volume for 50 miles as it takes in the streams of the Sierra and continue southward of its own gravity until it comes to rest in the San Fernando reservoirs.

The first 21 miles of the aqueduct consists of a canal 38 ft. wide at the bottom, 59 ft. wide at the water level and 10 ft. deep. This canal will have a capacity of 500,000,000 gallons daily. It is being constructed along the bottom of the valley where the land is little above the elevation of the river. Water is found at a few feet from the surface so that the work is being accomplished with centrifugal dredgers.

At the toe of the Alabama foothills, the canal ends and the conduit section begins. There is 39 miles of this open conduit, approximately 24 ft. wide and 12 ft. deep, the walls to be of rubble cement. This conduit follows a contour of the mountains, receives the flow of numerous small mountain



1—Antelope Division, Howard's Contract; Shovel in a Cut 16.3 Ft. Wide; 2—Half-Mile Concrete Aqueduct, Complete Except Cover; Mojave Desert, 18 Miles North of Mojave; 3—Concrete Cover on Mojave Aqueduct; 4—South Portal of Elizabeth Lake Tunnel, 26,860 Ft. Long

streams and carries the water around the alkaline Owens lake at an elevation of 200 ft. above its surface, to empty into the Haiwee reservoir. The aqueduct from the intake to this reservoir is of large dimensions in order to take care of the spring floods in the mountains. The Haiwee reservoir (Indian name for "The meeting place of doves"), with a capacity of 21,800,000,000 gallons and an area of 7 square miles, is designed to regulate and impound the storm waters and to clarify and regulate the flow through the aqueduct to the southward.

From the Haiwee reservoir the water will be carried in a closed conduit 138 miles along the edge of the Mojave desert, sometimes 1,200 ft. above the desert floor, through the Red Rock bad lands, across the Antelope valley and into the Fairmont reservoir at the northern base of the Coast range. This conduit varies in dimensions according to the grade, but it is on an average of 10 ft. wide by 10 ft. deep. The walls of the conduit and of the tunnels are of concrete from 5 to 9 in. thick and the roof is a flat reinforced concrete slab strengthened by concrete girders as shown in the illustration. Canyons are to be crossed by inverted siphons—steel pipes 8 to 9 ft. in diameter and 7/8 in. in thickness, while the smaller depressions will be crossed by flumes. This 138 miles of conduit will have a capacity of 280,000,000 gallons per day.

The Fairmont reservoir will have a capacity of 2,490,000,000 gallons and is designed to regulate the flow through the 5-mile tunnel under the Coast range. This tunnel, named the Elizabeth, is sufficiently large to run a street car through.

Once on the south side of the range, the water will be conveyed through short tunnels and steel pressure pipes for three miles along the rim of the San Francisquito canyon then plunged down 700 ft. upon the waterwheels of the first electric power house. The water will then be carried 14 miles farther on through tunnels and conduit to another point where there is a fall of 400 ft. and here a second power house will be erected. Thence the water reaches its final outlet in the San Fernando reservoirs. These basins, with an aggregate capacity of 12,000,000,000 gallons, will serve to regulate the flow of water as it comes from power houses, conserve the winter supply and serve in summer to give up a far larger quantity than the flow of the conduit will permit. While the conduit will be capable of delivering only 280,000,000 gallons daily, these reservoirs by impounding the surplus winter flow will permit of the use of more than 300,000,000 gallons per month during the long dry period of heavy draft. Perched high on the rim of the San Fernando valley these reservoirs will be capable of irrigating the entire valley wherever irrigation is needed, and through steel pipes pour down their golden blessing upon the city of Los Angeles, 20 miles away, and other towns and villages contiguous.

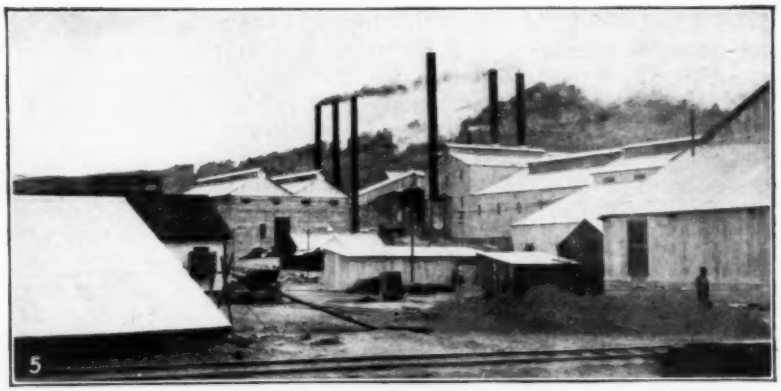
The development of 60,000 hp. of electrical energy has been provided for in the plans, but it is not included in the estimate of $24,500,000 as the cost of the aqueduct. The power development with the transmission equipment, it is estimated, will cost $6,500,000. A bond issue for half of this amount is shortly to be submitted to the people.

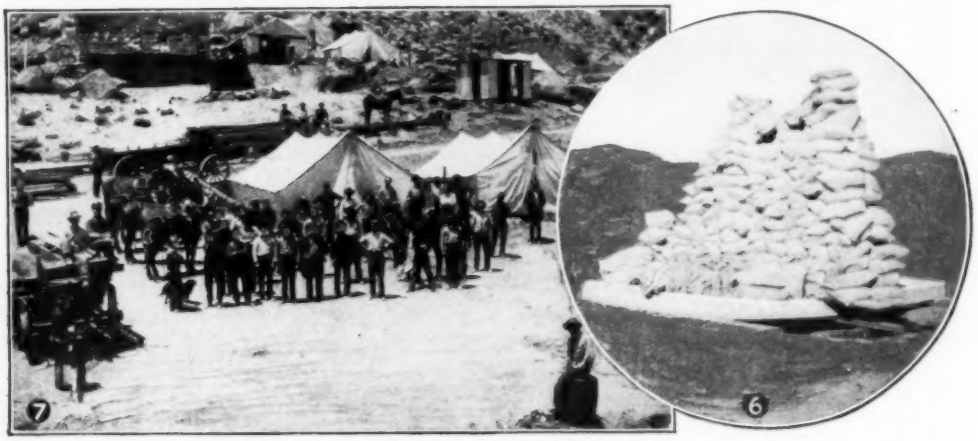
A classification of the construction shows:

Tunnels	38.51	Miles
Covered Conduit	100.35	"
Uncovered Conduit	41.55	"
Canal	20.83	"
Siphons	13.08	"
Flumes	.25	"
Total	214.57	Miles

The remainder of the distance is made up of reservoir area.

Told in a few words, this is the system of tunnels, reservoirs and canals which it has taken a dozen engineers and several hundred assistants four





5—Aqueduct Cement Mill, Only Municipal Plant in the World; Capacity, 30,000 Bbl. per Month; 6—Testing Cover for Conduit; 7—Camps for Army of Workmen; 8—Hauling Materials to the Aqueduct Line with Caterpillar Engine First Used by the English in the Boer War

years to develop and mark out in a long line of surveyor's stakes across the country.

Let us now turn to the almost insurmountable obstacles which Nature had set up to guard these waters of the mountains in their dark canyons. William Mulholland, the chief engineer, asserts that the plan of the aqueduct is extremely simple and so, perhaps, it is, but the campaign of preparation was not at all simple. It forms by far the most interesting part of the story. The degree of perfection with which this preparation was accomplished, accounts for the wonderful progress now being made.

Three years after the building of the Los Angeles aqueduct was determined upon, the first shovelful of earth was thrown in the excavation of the conduit. The interval was passed in getting ready for the Herculean work to come. When Wm. Mulholland and his chief assistant, J. B. Lippincott, began, the Mojave desert for 140 miles lay gray as a dead man's hand. By hook or by crook preparation had to be made for the army of 5,000 workmen yet to come. It was estimated that 1,100,000 bbl. of cement, and 23,457,000 lb. of steel for the conduit and siphons must be placed in the field. To excavate the 8,500,000 cu. yd. of loose earth and 1,027,769 cu. yd. of rock, heavy machinery must be provided and placed on the work. For the transportation of these things there was no railroad and no wagon road for 120 miles. There was no means of communication but a stage coach, one of the last survivors of the gold crazed days of 1849. There was no water excepting at 20 or 30-mile intervals—water holes in a thirsty land—and the mountains lay bleak and bare and desolate as the desert. No food, no shelter, not even wood for the camp fire was offered.

When the city was on the eve of constructing a standard steam gauge railroad to be operated by the municipality, a contract was concluded with the Southern Pacific company by which it agreed to parallel the aqueduct so far as possible with the transportation facilities desired. This road is now in operation for 100 miles.

At many points, however, the aqueduct lies 1,200 ft. above the floor of the desert and is practically inaccessible in places even to burros. To overcome this obstacle the city has built 216 miles of roads and trails, some of the former at a cost of $5,000 per mile. Where road or trail is impractical, electric hoists and cableways have been built and the materials are raised by this method. Over the roads a cheap method of hauling had to be devised and for this the caterpillar engine was pressed into service. This engine first used by the English in the Boer war and now a part of their military equipment was made over by aqueduct engineers to suit the needs of the city and has well proved its worth in hauling heavy wagons over the sandy desert and up the steep hillsides.

Water was found far back in the mountains and by four waterworks systems brought down to the aqueduct zone and piped for 146 miles along the aqueduct, with concrete reservoirs on the mountain tops for reserve supply.

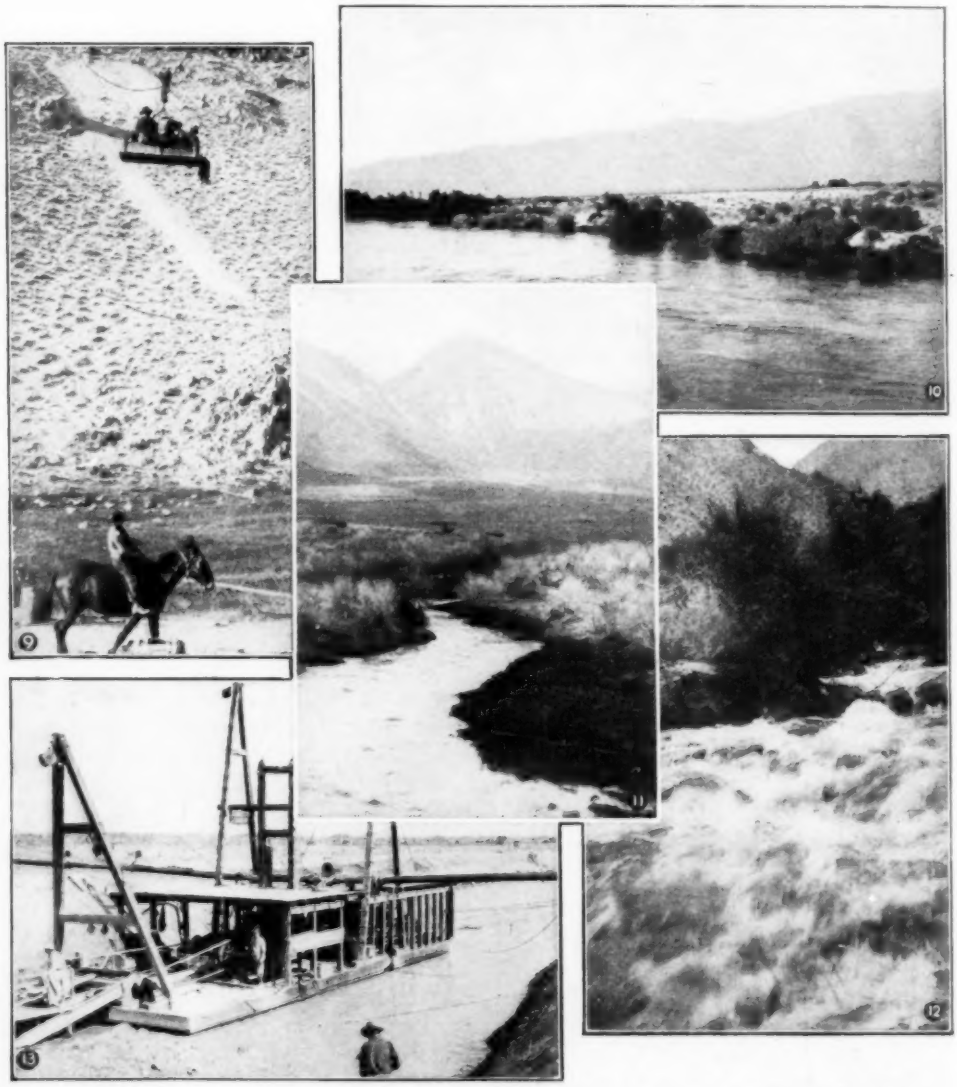
For power to drive the tunnel machinery and other excavating machinery, the engineers went to the Owens river valley and built three hydro-electric power houses to develop 3,500 hp., then carried the electric current over 218 miles of high voltage wires to wherever power is needed.

To provide communication, the city has constructed a telephone system 351 miles in length from the central headquarters to the intake. The system has its own switchboards and day and night operators. Each of the 60 camps is therefore, under the constant supervision of the chief engineers.

When this labor of preparation had been accomplished it was necessary to provide accommodations for the laboring army now ready to be drafted and sent to the front. To this end hundreds of tents were erected in the field

and bunk houses, mess rooms, warehouses, residences for the division engineers, offices, hospitals, power houses, stables, etc., etc., went up like magic until a total of more than 350 buildings had been erected.

The largest item of expense for material is that of cement. The city has therefore gone into the cement business to save freight and manufacturer's



9—Aerial Hoist in Sand Canyon; 10—Owens River, Below All Diversions, Near Independence Bridge; 11—Division Creek on the Rickey Ranch; 12—Cottonwood Creek, a Tributary of the Aqueduct

profits. Excellent deposits of clay and limestone, the materials from which cement is made, were discovered near the town of Tehachapi on the Southern Pacific railroad, 12 miles from the line of the aqueduct and equidistant from the aqueduct intake and outlet. Here, Los Angeles, at a cost of more than half a million dollars, has erected a modern cement mill and is making 1,200

bbl. of cement per day. Here the city maintains a force of 175 men and owns the townsite of Monolith which boasts of water and sewerage systems, a fire department, stores, a school and a church.

The force now at work approximates 4,500 men. The excavation is being carried on by three great dredges, 12 steam shovels and a large tunnel equipment of high power drills, muckers, and electric tunnel railroads which carry the muck from the faces to the portals. With 38 miles of tunnel to be constructed *and 26 miles of this accomplished in the past thirteen months* some idea of the rapidity of the construction can be gained.

In order that aqueduct building can be carried on in a systematic way, the line of the aqueduct is divided into 11 divisions ranging from 6 to 23 miles in length, depending upon the character of the work. In every division where construction is in progress an assistant engineer is in charge with superintendents, foremen, master mechanics, transportation system, etc., under his supervision and administration. In each division there is also maintained a thoroughly equipped hospital corps and well organized accounting and storekeeping departments.

At the present time, approximately 75 miles of excavation have been accomplished, and it is estimated that by the spring of 1913 the longest aqueduct in the world will be completed and in operation.

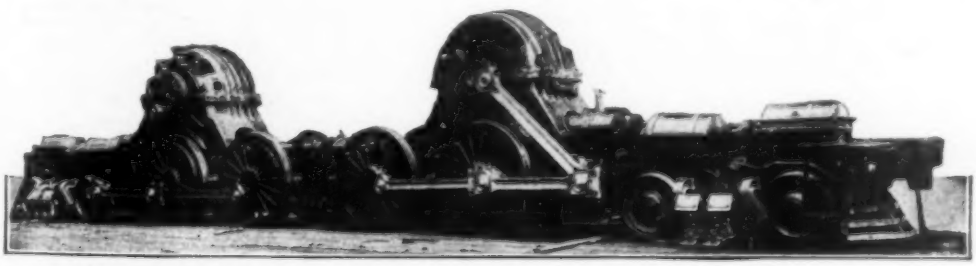
The committee on conservation of national resources urges the railroads to economize as much as possible in the use of coal.

ELECTRIC LOCOMOTIVE OF 4,000 HP.

The first of the electric locomotives to be used in the New York tunnel extension of the Pennsylvania railroad is shown in these two illustrations, one of which was taken before the cabs were placed in position. This great engine, 24 of which are now being built, weighs 330,000 lb., and will develop 4,000 hp., which is about three times as much as a giant steam locomotive. It is claimed that it could pull a heavy freight train at a speed of from 60 to 70 miles an hour. The mission of itself and companions will be to haul some 1,000 trains in and out of New York every day.

The engine is built in two sections; that is, there are two cabs and two running gears, joined in the middle. Each section has eight wheels, four of which are drivers, and are permanently coupled back to back by friction draft gear and levers, so that the leading section effectually pilots the rear one. This obviates all necessity of turning the engine, as it runs equally well in either direction, and all manipulating levers are duplicated in each section.

Distinctive from steam practice, all rods and moving parts have pure rotation only, and are thus counterbalanced for all speeds, thereby delivering no more shock to the track and roadbed than would a passenger car of equal weight. The motor and massive side frames, jack shaft, and all other gear, are spring supported from the driver and truck wheels, so there is no track stress other than that local to a single pair of wheels. Earlier types of elec-

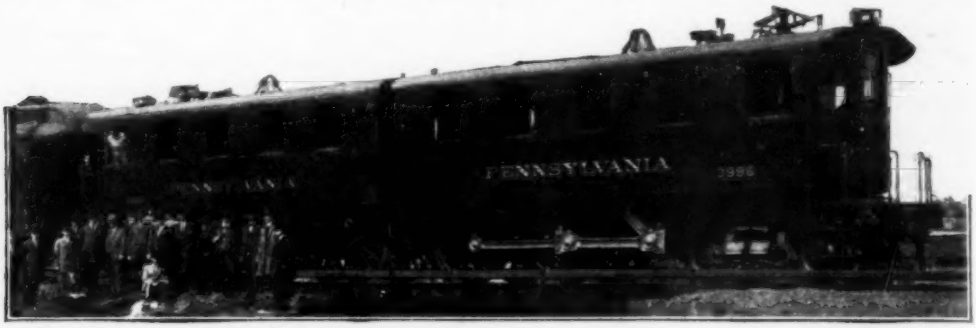


Electric Locomotive without Cabs

tric locomotives do not possess these features, the purpose of which is to utilize on the drive wheels direct the naturally continuous rotation of the motor.

The electric supply will be secured from an electric conductor, or third rail, by four contact shoes on each locomotive. At some points where the great number of track switches will not permit this, power will be secured from an overhead conductor through an air-operated overhead contact shoe, of which there are two on each of the locomotives.

The steel cabs conceal the giant motors with which the driving rods connect, but the illustration of the chassis gives an excellent idea of their size and construction.



A 330,000-Lb. Electric Locomotive

The 24 locomotives will have the following dimensions:

Total weight, 166 tons.
Weight of electrical parts, 62 tons.
Weight of mechanical parts, 103 tons.
Total horsepower, 4,000.
Maximum draw-bar pull, 60,000 lb.
Maximum speed, 60 to 70 miles per hour under load.
Diameter of drive wheels, 68 in.
Diameter of truck wheels, 36 in.
Weight on drivers, 14 tons.
Mechanical shock without injury, 600,000 lb.
Length over all, 65 ft.
Total wheel base, 56 ft.

NEW METAL LIGHTER THAN ALUMINUM

A great chemical factory at Höchst on the Main, Germany, exhibited a new metal at the Frankfort aeronautic exposition that is said to be as strong as the best aluminum alloys and but half as heavy. It is called "elektron" and has a specific weight of 1.8 as compared to 2.9 of the best aluminum. Bolts and bars that would ordinarily be thought of as heavy were placed on exhibition, and when handled seemed as light as papier maché.

LOSSES ON THE GREAT LAKES

Up to Nov. 1 of the past season of navigation on the Great Lakes, the loss in lives was 95 and the property loss over $2,000,000. Of the 95 lives lost, 65 were drowned in wrecks, while the others are accounted for by accidental drownings and accidents on board vessels.

The total property loss in gales was $605,000; loss in collisions $632,000; 18 vessels were total losses, and the number of collisions was 24. The greatest loss of life occurred on July 12, when the "John B. Cowle" was rammed in Lake Superior by the "Isaac M. Walton," drowning 14 of the former's crew.

EXCITING AERO-SWIMMING GAME

The novel and exciting aero-swimming game shown on the opposite page is the result of the world-wide interest that is now commanded by the aeroplane. It was first thought of by members of the Clapton Ladies' Swimming Club in London and furnished so much enjoyment as the feature of one of the

Courtesy Illus. London News

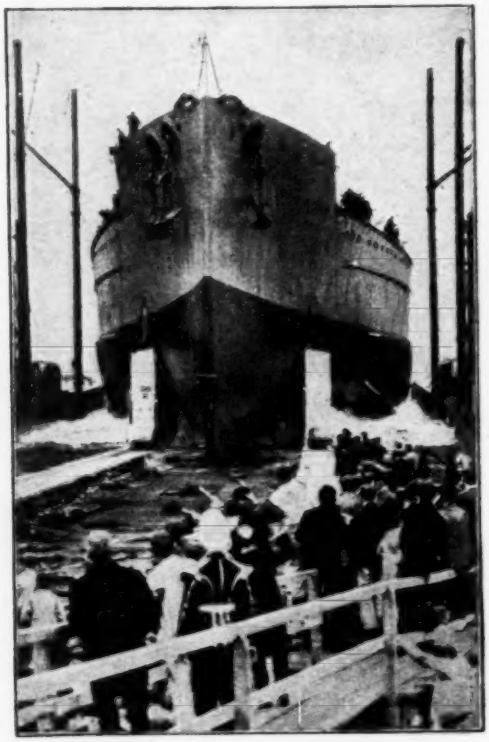
A Short Flight and a Bath

gala nights of that club that the idea is rapidly spreading.

Provided with miniature aeroplanes, or gliders, of various designs, the participants in the sport jumped forward over the tank from a platform, and after sailing several feet lightly dropped into the water.

LARGEST BATTLESHIP AFLOAT

The H. M. S. "Neptune," launched the latter part of September, is the largest battleship afloat, and probably will remain so until the launching of the American 26,000-ton "Dreadnought Destroyers," not yet laid down. It will be nearly two years, however, before the "Neptune" is ready for commission. Her displacement is 20,230 tons; length, 600 ft.; beam, 86 ft.; and required speed, 24½ miles an hour. Her great beam is shown in one of the illustrations. Like her sister ships, she will carry ten 12-in. guns, but they are so arranged that all ten can be fired on either broadside. This improvement in the British fighters draws attention to the fact that the U. S. S. "North Dakota," now completed, and the U. S. S. "Delaware," which may be completed before this issue reaches the public, each have ten 12-in. guns which can be fired on either broadside, and are, at the present, the biggest and most powerful warships ready to fight. Although only 519 ft. long, which is 81 ft. shorter than the "Neptune," they are only 230 tons less in displacement, and only 1 ft. narrower in beam.

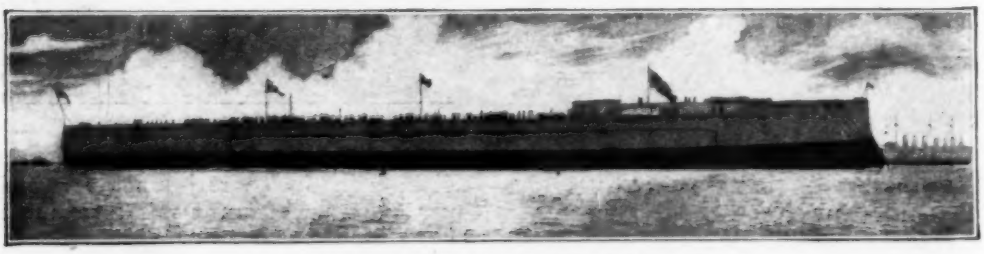


The Plunge into the Waters

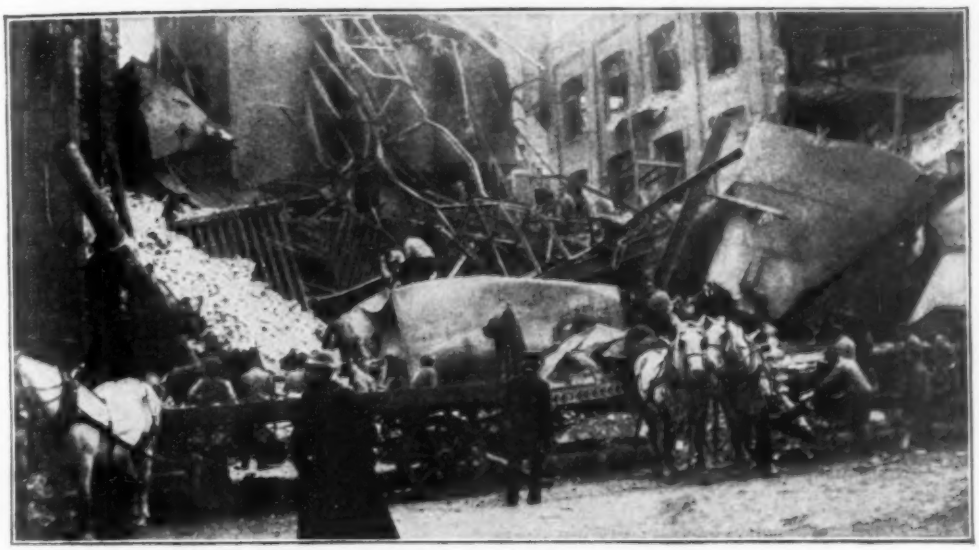
Still another reason for America to feel proud is the fact that the 26,000-ton battleships, "Arkansas and "Wyoming," now under contract, are far more powerful than any ship contracted for or even as yet authorized by any other nation. They are to be 545 ft. long, with a beam of 92 ft., which is 6 ft. wider than the "Neptune," and they are to carry twelve 12-in. guns, all capable of firing on either broadside, which is two more big guns than the "Neptune" carries. They are rated for a speed of 24½ miles, have side armor 8 in. thick, and belt and barbette armor 11 in. thick, and will carry 1,100 officers and men.

VALUABLE COTTON CROP

If the present prices prevail through the crop season, it is probable that the cotton crop will be worth from $800,000,000 to $900,000,000 to the south. The crop of 1908 was valued at $683,000,000, not including the seed.



The "Neptune" Just After Launching



Remains of 6-Story Power Plant

BOILER EXPLOSION MOVES BIG BUILDING FOUR FEET

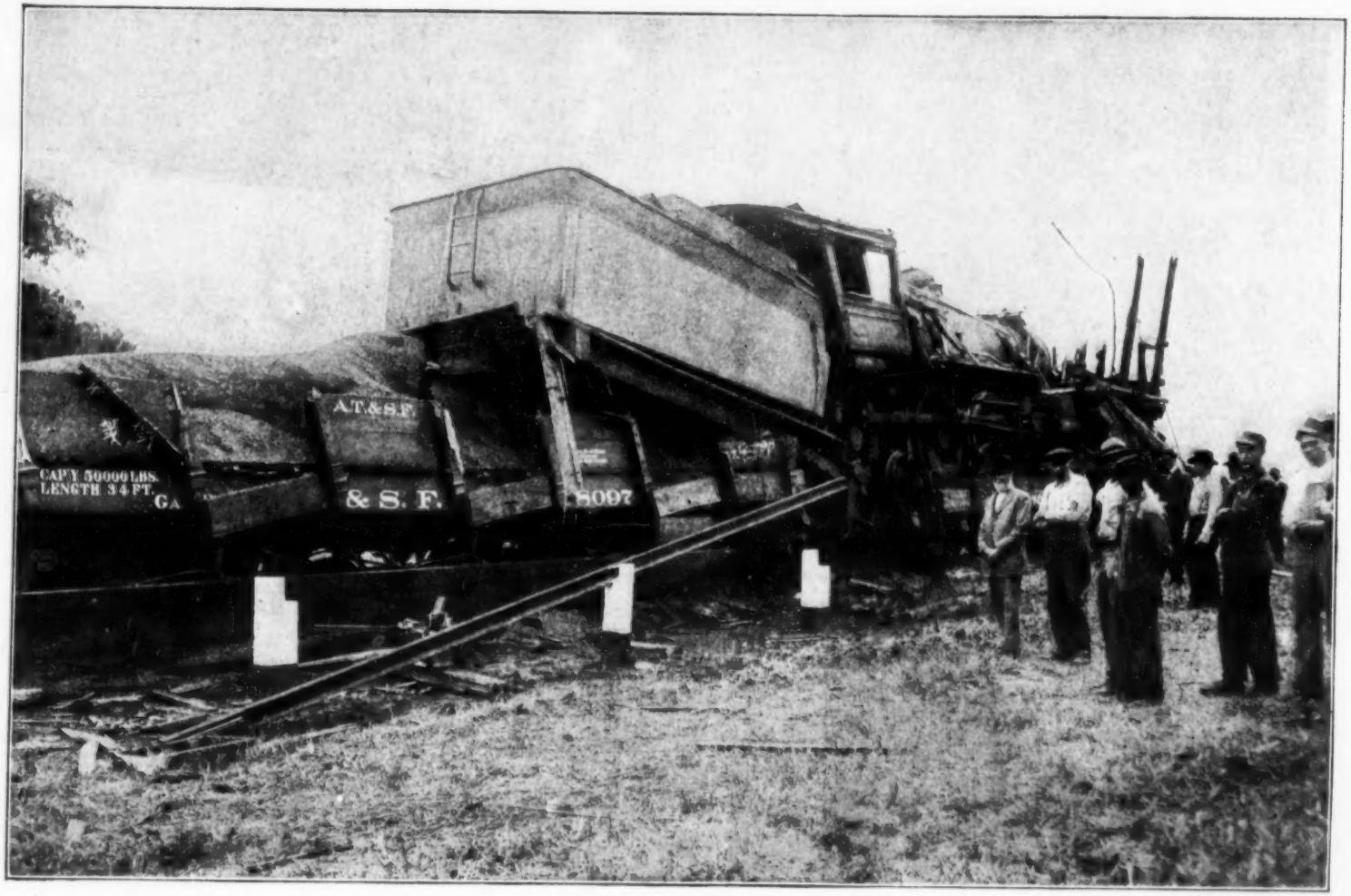
An explosion of boilers in the plant of the Pabst Brewing Co., in Milwaukee, resulted in the loss of one life and an enormous destruction of property. Following the bursting of the 18-in. steam pipe leading to the engine rooms, four new boilers, each of 400 hp., exploded. The building in which they were located was a new 6-story structure, and after the explosion nothing remained but a mass of brick and twisted iron.

The most curious incident of the explosion was the manner in which a 6-story malt elevator standing next to the wrecked power plant was affected. The concussion moved it 4 ft. upon its foundation, but a brick chimney, 230 ft. high, still nearer the explosion, was not disturbed in any way.

Parts of other buildings were torn away or blown in, adjoining streets and alleys were buried under tons of wreckage, great pieces of pipe and flues were scattered in all directions, fires were started on neighboring roofs by the fall of heavy sections of torn boilers, and windows were broken for blocks around. The detonations of the exploding boilers, the shocks coming one after another, were heard all over the city.

The fact that the accident occurred at four o'clock in the morning accounted for the small loss of life.

Section of Boiler Thrown Several Hundred Feet



Wreck That Cost 16 Lives

ENGINE RUNS OVER TOP OF TRAIN

In a recent rear-end collision between a heavily loaded oil train and a work train loaded with gravel near Topeka, Kan., 16 Mexican workmen were almost instantly killed and 25 seriously injured. The engine of the oil train cut its way through the trailer of the work train, in which the men killed and injured were riding, and breaking away from its train ran over the tops of six of the flat cars, dragging its tender after it. It stopped on top of the seventh car, and the engineer, who had stayed at his post, stepped from his battered cab uninjured.

A BASTILE OF THE SOUTHWEST

There is a seeming touch of irony in the sign "city jail" on this crude bastile of a "city" of the southwest. In the "boom" days of the west, however, cities grew in a night, and often as rapidly faded away, but with the first crude buildings and the incentive of law and order came the "city jail."

A Relic of Early Days

A ROLLER-SKATING COASTER

The most unusual feature of the Empress skating rink at Earl's Court, London, is the skating switch-back, a structure built on the same design as the ordinary summer park scenic railway or roller coaster, but very much different in the fact that the patrons run over it on roller skates instead of in cars. It stretches from end to end of the big rink, and offers sufficient excitement to satisfy the most thirsty hunter of thrills.

Courtesy Illus. London News

Roller Coasting on Skates

The rink of which it forms an additional attraction has a skating area of 60,000 sq. ft., and will accommodate 4,200 skaters.

AN OVER-CROP OF RAISIN GRAPES

Raisin grapes were over-produced to such an extent in the Cucamonga section in the southern part of California, that, according to reports from the west, they are being used as horse feed. One farmer found it impossible to find a market for 50 tons of dried grapes produced from a 30-acre vineyard, and sold the crop for $1 per 100-lb. sack. Practically the whole supply was used as horse food.

ESCAPES TO SURFACE THROUGH TORPEDO TUBE

For the purpose of demonstrating the possibility of an escape from a submerged submarine through a torpedo tube, Midshipman Kenneth Whiting, in command of the submarine "Porpoise," now at Manila, had his little vessel lowered to the bottom of the bay near Cavite. Then, at a depth of probably 30 or 35 ft., he crawled into the torpedo tube, the inner end was closed behind him, and the experiment was made.

The outer end of a torpedo tube in a submarine is closed by a port, which is moved by powerful machinery within the boat. When under water the pressure of the water against the port cover is great, and when it is swung open the inrush of water as the torpedo flies out is powerful. Whiting took hold of this port and went with it as it was swung out, clearing himself of the tube as he did so. He then let go, flying upward to the surface in safety.

The whole operation consumed about 75 seconds, and many officers consider it a miracle that the ensign did not drown while leaving the tube. Some years ago the same experiment was tried at Newport, the chief actor being a dog. The animal, of course, could not help himself in any way, and the attempt to blow him clear of the tube was unsuccessful.

According to the builders of submarines, there are more ways than one of escaping from a submerged warship, any one of which is far safer than that resorted to by Whiting, which, they believe, was a wholly unnecessary piece of bravery that can never have the slightest bearing on the method of escape a submarine crew should adopt.

"We have methods by which men can escape from our submarines without danger," says one submarine builder of note. "Down from the top of every submarine that we build descend at least three portholes. These extend into the large rooms on the deck of the vessel, and each room is separated by bulkheads.

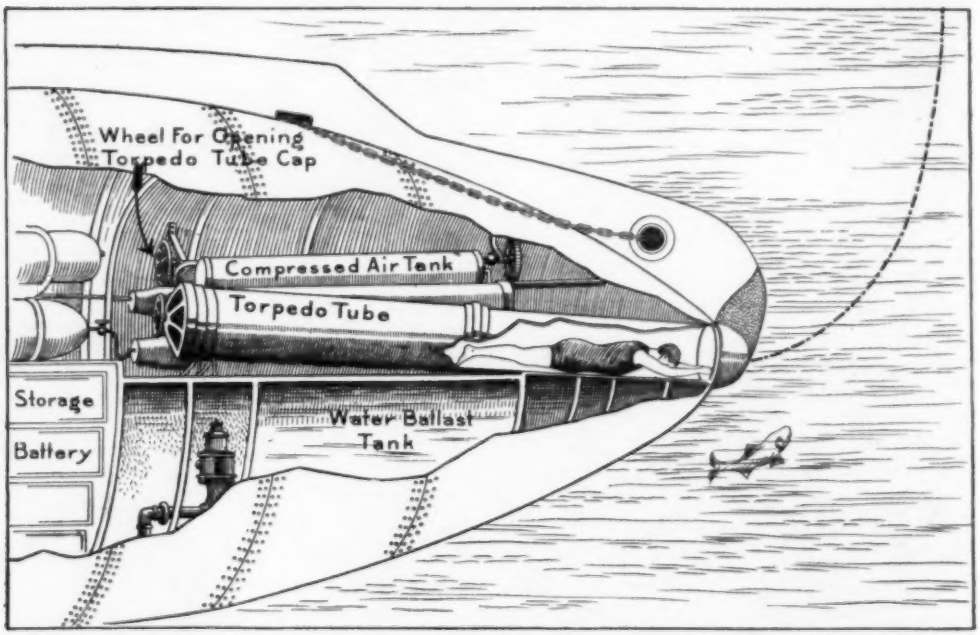


Diagram Explaining Dangerous Test

"We may suppose that the water is rising rapidly in the hull of the submarine and that it begins to creep up to the men, who are as near the top as they can get. They promptly stand up and group themselves around the different portholes in the roof. When they are in a standing position their heads will come above the bottom of the ports. Now the water rising in a submarine rises exactly as water rises in an up-turned tumbler when you force it below the surface of the water. We have determined by experiments that the water will rise to the level of the portholes and no farther.

"From the instruments the men know how far the boat lies beneath the surface and consequently they know how many pounds of pressure to the square inch is exerted by the water upon the surface of the boat. So they stand there, allowing the water to rise higher and higher around them until it reaches the bottom of the ports and their necks at the same time. But still they stand there without a move until the air pressure inside the boat is sufficient to equalize the water pressure outside the boat. As soon as the pressure is equalized one of the men standing around the port takes his life preserver in his hand, looks his comrades in the eyes and taking hold of the edge of the port slides under the water and up inside the port. A touch upon the trap door makes it fly open and the sailor plunges upward through the trap, while the door closes behind him.

"As soon as the first man has gone, the second man follows exactly in his steps. He ducks under water and comes up in the port. The door flies open and he plunges up to the surface. Man after man shoots up to the surface until no one remains in the submarine. If all else fail this method is safe."

PROJECTIBLE AEROPLANE FLARES

It is obvious that a searchlight, or any other kind of light, displayed from a dirigible balloon will vividly disclose the position of the aerial fighter to the enemy on the ground, thus tending to offset the advantage such illumination might otherwise give. To such an extent has the illumination problem been studied by the French military authorities, that a small projectible aeroplane

Courtesy Illus. London News

A Dirigible Aeroplane Searchlight

has been devised that can be launched from a dirigible and will carry a flare that sheds a bright light downwards on to the earth.

POTATOES PRESERVED ON COKE

A new method for keeping potatoes and preventing sprouting is reported by Richard Guenther, U. S. consul at Frankfort, Germany. It consists of placing them on a layer of coke, and Doctor Schiller, of Brunswick, who is responsible for the idea, is of the opinion that the improved ventilation thus gained is not alone responsible for the result.

He believes that it is due to the oxidation of the coke, which, however, is a very slow one. Coke contains sulphur, and he considers it quite possible that the minute quantities of oxides of carbon and sulphur which result from the oxidation, mixing with the air and penetrating among the potatoes, are sufficient to greatly retard sprouting.

Potatoes so treated are said to keep in good condition for a year.

Firemen Cleaning the Facade of the National Capitol

ANNUAL BATH OF THE CAPITOL

The Capitol receives its annual bath a short time before Congress convenes, the toilet articles used consisting of about 2,500 ft. of hose in the expert hands of one company of the fire department. Powerful streams of water, at high pressure, remove dust, spider webs, insects of all kinds, birds' nests, and other foreign substances from the many crevices.

All of the many statues and figures on or about the national structure are also given a thorough cleaning. Statesmen, soldiers, woodmen, Indian chiefs, hunters, and other figures symbolizing the history and progress of the country are subjected to the same treatment.

PIPES CLOGGED BY MINERAL SCALE

This illustration shows the mineral scale which clogged a section of 4-in. pipe. The pipe was in use about four years as an overflow from a hot-water tank which received the water from the jackets of three 125-hp. gasoline engines. The engines received the water

Effect of Mineral-Charged Water

from an artesian well which shows a small per cent of lime and magnesia. —Photo by G. A. Hazen, Pittsburg.

HOOP DESIGN FOR CUT FLOWERS

This illustration shows a florist's idea of a satisfactory design for floral display. The arrangement consists of ordinary tumblers fastened by clips and

A Ring of Cut Flowers

hooks to a large metal ring. It is intended as a drop decoration for chandeliers, for the centers of tables, and for porch decoration.

CAT RESISTS 50,000 VOLTS

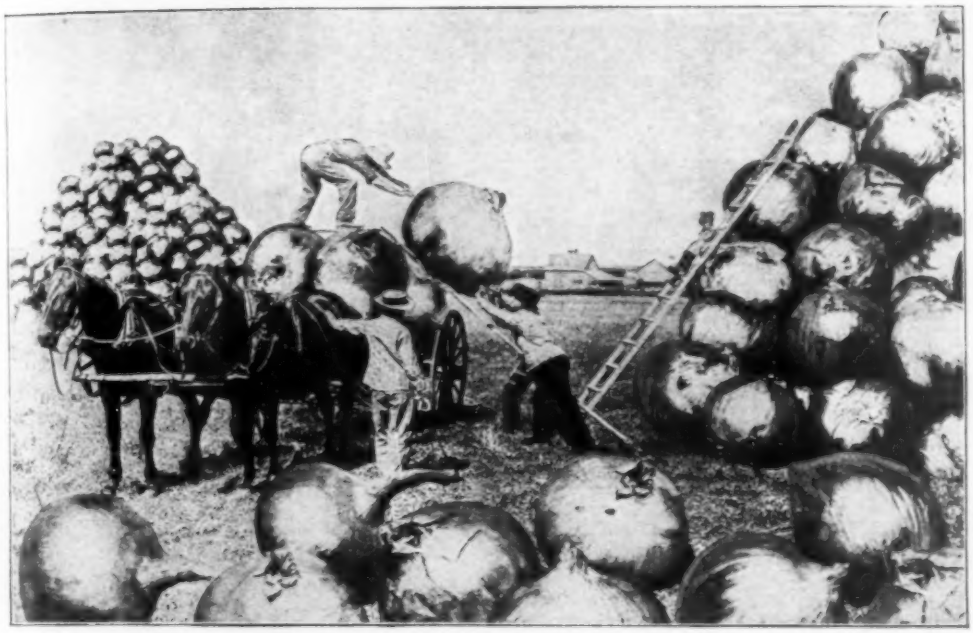
A tramp cat wandered into the Port Townsend, Wash., wireless station, according to a story in a Californian publication, and before it was detected had walked across the transformer wires, receiving nearly 50,000 volts of electricity. The contact completely extinguished the spark of the receiver and temporarily interrupted service, but the only effect on the cat was to make it howl piteously, while every hair on its body stood out like the quills of a porcupine. It at last dropped helplessly from the wires to the floor, a distance of nearly 20 ft., but an instant later sprang up and darted out through the open window. It was seen again a few hours later in apparently good condition.

About 1,800,000,000 hen's eggs were laid in the United States last year.

PHOTOGRAPHED AT MOMENT OF ACCIDENT

In an automobile racing meet at Oakland, Cal., last summer, one man was killed and another seriously injured. This, however, has become an expected occurrence at such meetings and draws but little attention except locally, unless the persons killed or injured are very well known, but in this instance the quickness of a photographer resulted in a picture much out of the ordinary. A spectator of the races started to run across the track as a car, running 57 miles an hour, approached. The photographer, who was standing near, saw the man and the car, and, unable to do more than shout a warning, focussed his camera upon the man. He waited until the moment the automobile struck, then pressed the bulb with the result shown. The man was thrown 50 ft. and instantly killed, the driver of the car was thrown half as far and seriously injured, and the car was wrecked. The other photograph shows the wrecked car being removed from the track.

At the Moment the Victim Was Struck—Removing Wrecked Car



Tier on Tier of Tear-Producing Vegetables

INDIANA ONIONS

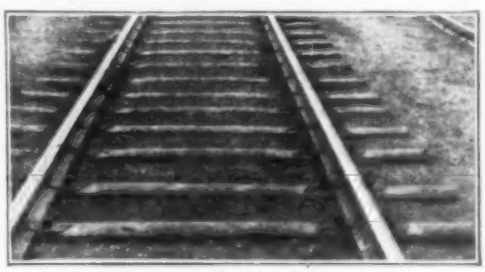
How strange it is that the moment attention is drawn to one record-breaking thing many other record-breaking things in the same line are reported. A huge photographic cabbage was given space in these pages, and as a result many other instances of huge photographic growths were discovered. The present subject is a great crop of onions in Indiana.

STEEL CROSS-TIES ON PENNSYLVANIA SYSTEM

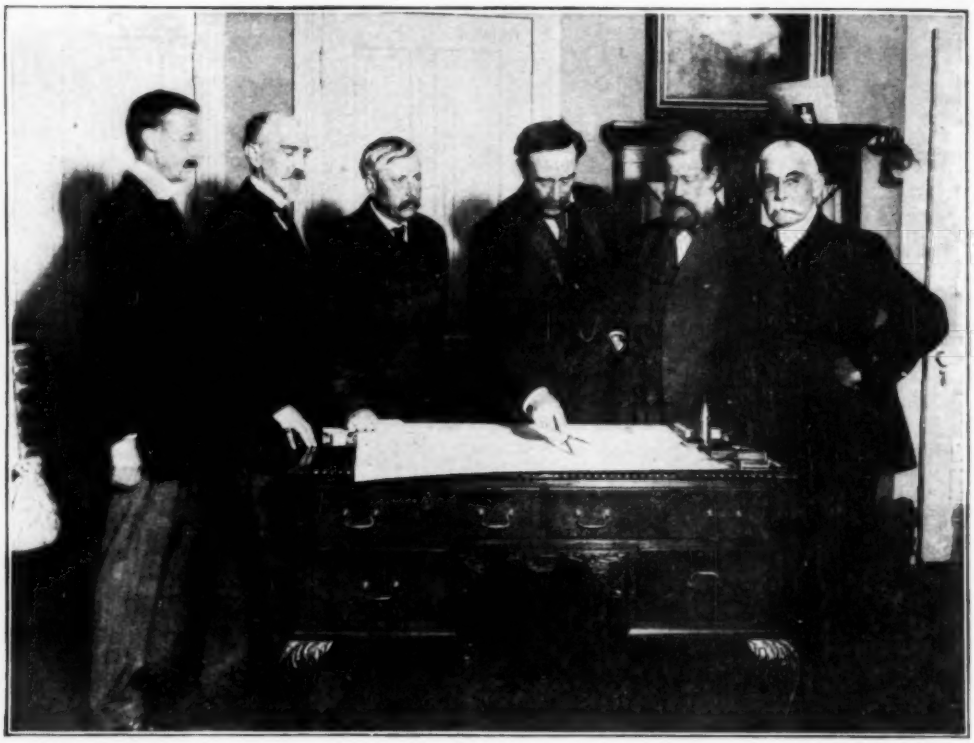
Although steel railroad ties have been used to a great extent on European railroads for many years they have not found favor until recently in America, many engineers considering it impossible to produce in such ties the same elasticity and resilience contained in wooden ties.

Now, however, urged by the necessity of added strength and wear, many of the American railroads are experimenting with different types of steel ties to determine which most nearly contains the requirements mentioned. The illustration shows a stretch of such ties on the Pennsylvania railroad at Conegaugh. They are 8 ft. long, 7 in. wide on the face, have a depth of 6 in., and consist of a steel casing 3/16 in. thick with an open bottom having the lower edges curved inwardly. The interior of the tie is filled with a mixture of asphalt.

It is claimed that the coefficient of elasticity of the steel casing and the asphalt filling is practically uniform, and that the vibration is taken up thereby, providing a practically noiseless track.



A Stretch of Steel Railroad Ties



Left to Right—Gilbert H. Grosvenor, Editor National Geographic Magazine; O. H. Tittman, Prof. Willis L. Moore, Chief of U. S. Weather Bureau; Robert E. Peary, Henry Gannett, and Admiral C. M. Chester.

MEMBERS OF THE POLAR COMMISSION

The accompanying photograph is of the Committee of the National Geographic Society appointed to pass on the claims of Robert E. Peary. It shows Peary pointing out the route to the North Pole.—Photo taken at Washington, D. C., November 2, 1909.

SPECIAL GASOLINE FOR AEROPLANES

Realizing that the safety of the aviator depends upon the reliability of his fuel and engine as much as with the correctness of his planes, one of the foremost English oil companies has introduced a specially prepared gasoline for the use of aeroplane engines. It is called aero-naph, and its specific gravity and boiling-point have been carefully determined.

RIGHT AND WRONG WAYS OF DRIVING AUTOMOBILES

The mere matter of driving an automobile in the sense of getting it to a given point and back again without an accident is a comparatively easy and simple accomplishment, even to a beginner with but little practice. But, according to the Automobile Dealer and Repairer, there is a right and a wrong way, an easy and awkward way, and sometimes a safe and dangerous way of carrying out a number of necessary operations. These ways, which are the little tricks of the trade distinguishing a really good driver from an amateur, are explained in the drawings.

Figure 1, for instance, shows a fierceness of grip on the gear lever which is faulty with many drivers. Unless there is some defect in the mechanism actuated by the movement of the lever, making the latter excessively stiff to operate, such a grip is not only unnec-

essary but a distinct disadvantage, tending to encourage undue roughness and force in changing the gear.

The correct handling of the lever is shown in Figs. 2 and 3. It gives all the grip and certainty of movement that is required, and there is no implied necessity for great force as in Fig. 1. Figure 2 shows the correct hold for the movement, and Fig. 3 shows the finish of the movement, or ready for the backward pull. Figure 4 shows an alternate method of holding the lever for a movement back and outwardly across the gate that is particularly suitable for some gears, especially when the sliding shaft of the lever is liable to bind in crossing the gate.

Figures 5 and 6 show two ways of holding the steering wheel, the former being considered awkward, while the latter is far more natural and comfortable. Also, when the wheel is held in such manner as shown in Fig. 6, and it becomes necessary to reach for the lever when it is in its forward position, there is no tendency for the movement of the body to cause a pressure of the left hand on the wheel that might turn it and swerve the automobile from its path.

Figure 7 defines a position of the foot that is not to be recommended when the clutch is "in" and the brake "off." The heel, if not the whole of the foot, should be kept firmly on the floorboard,

1—Fierce Grip a Bad Method; 2—Correct Hold for Forward Movement; 3—Finish of Forward Movement; 4—Alternative Grip Suitable for Many Gears; 5—Awkward Hold of Wheel; 6—Proper and Comfortable Hold; 7—Wrong Foot Position; 8—Nervous, Uncomfortable Position; 9—Careless, Lounging Position; 10—A Correct "Seat"

for, by resting the weight of the foot on the clutch pedal, a large amount of unnecessary friction and wear takes place at the clutch fork. Also there is a liability that the clutch may sooner or later be caused to slip.

Figures 8 and 9 show awkward and ungraceful positions in "seats." The former, apparently nervous and uncomfortable seat, is frequently adopted by beginners, while the latter shows an inclination to carelessness, much to be decried. Figure 10 shows a seat that is not awkward and stiff, nor careless, but it is a comfortable seat that adds to certainty of proper manipulation of steering gear and controls.

Chemical extinguishers are exceedingly good electrical conductors.

REMARKABLE PHOTO OF 12-INCH GUN DISCHARGE

The photograph here shown is remarkable because of the difficulties overcome in its taking. The tremendous concussion and jar of the discharge of a 12-in. gun is sufficient to blur almost any impression. The photograph was taken during the practice off the Virginia capes last summer. The broad expanse of clear deck shown gives an excellent idea of a ship cleared for action. The heavy pall of smoke is made by the 206 lb. of powder used to discharge an 850-lb. projectile.

A Moment After the Projectile Has Started

So efficient are the gun crews in handling these immense rifles that they can load and be ready for firing in 18 seconds. The range finding is done from the fighting-tops, high above the smoke. In the recent practice a target 25 ft. square, and two miles distant, was hit 16 times out of 16 shots in more than one instance, the ships being under way at the time.

MONORAIL CAR CARRIES 40 PEOPLE

The Brennan monorail railway, which works on the principle of a gyroscope and was first experimented with in model form two years ago, received its first public demonstration on a full scale at the war office grounds near London in November. The car used was built under a subsidy from the government, and is 40 ft. long, 10 ft. wide, 13 ft. high, and weighs 22 tons.

Those who watched, witnessed a

spectacle as marvelous and as revolutionary from the standpoint of transportation as that which aeroplanes have furnished in the past two years. They saw this great car, loaded with 40 persons, and mounted on a single rail, running freely about curves of all sorts with safety as complete as on the ordinary passenger car, and with far less vibration. It ran in a circle an eighth of a mile in circumference at a speed of 25 miles an hour without the slightest tendency to leave the track. Two gyroscopes, weighing ¾ ton each, automatically supplied perfect stability, making 3,000 revolutions a minute in vacuo. The motive power is a gasoline engine of 80 hp.

The demonstration aroused unbounded enthusiasm among the engineering experts present. They were specially interested in the weird effects of the gyroscope principle, one of which was that when the 40 passengers were all crowded upon one side of the car the result was not the depression of that side under the unbalancing pressure, but paradoxically the opposite. The more weight added to one side, the higher that side rose as the gyroscopes sought to balance the unequal load.

The efficiency of the gyroscope principle, according to the experts present, was found to be far greater proportionately in the full-sized car than in the model. Mr. Brennan believes that a car double or triple the size of the present one will attain a speed of more than 100 miles an hour with greater safety than 60 miles an hour on a 2-rail road. The present car has four wheels in direct line with each other, and the machinery is contained in a cab in the front part. The rail used closely resembles an ordinary one, except that the top is more curved and the rims of the wheel correspond to the curve.

NEW WAY OF CARRYING WINE

The method of carrying bottled wine shown in this illustration may seem new to the majority of readers, but in Surinam, Dutch Guiana, it is a familiar practice. Many of the servants are so well accustomed to such a means of carrying that they actually run on their errands without fear of coming to grief. It must not be presumed, however, that

Carrying Wine Home in Dutch Guiana

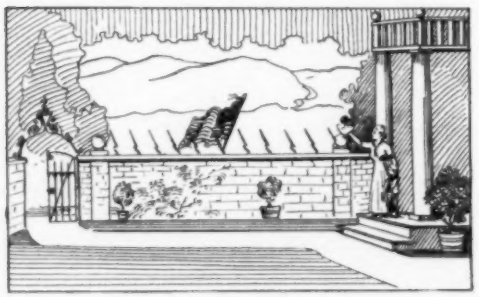
wine is the only article they carry in this manner. Articles weighing as much as 100 lb. are so carried without the least inconvenience.

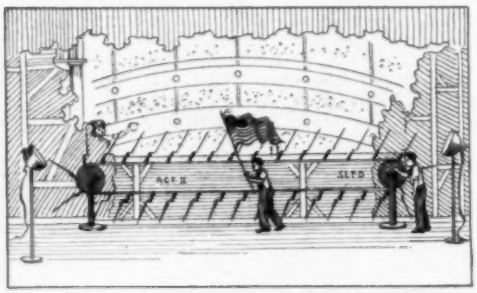
AERIAL SHAM BATTLE TAKES PLACE IN GERMANY

The first aerial sham battle was held during the night of Nov. 2 at Cologne, Germany. The German airship squadron, consisting of the "Zeppelin II," "Parseval I," and the military airship "No. 2," executed a sham attack upon the Fortress Ehrenbreitstein, after they had surprised the garrison at Coblenz. The garrison at the fortress was also surprised, for the attack was rapidly made, but the great stronghold of the Rhine valley soon picked out the airships with its great battery of searchlights, and the aerial craft had to retreat to escape the hypothetical fire of the special aerial guns.

ARMY STAGE ILLUSION

It is frequently necessary in dramatic presentations, especially in plays dealing with war times, to show an army on the march either to or from





Ingenious Imitation Army

the scene of battle. To accomplish this without actually employing a large body of men to enact the soldiers has led to the devising of illusions which give all the effect without having the actual army make its appearance on the stage.

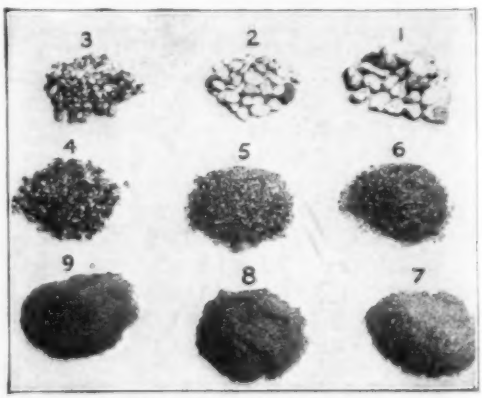
Not the least employed illusion for this purpose is the one illustrated herewith. The stage is set with a high wall at the back. Directly back of this wall, the illusion mechanism is placed. This consists of an endless belt operating over two rollers mounted at a suitable height at opposite sides of the stage. Fastened on this belt are a series of bayonets secured at suitable intervals—these intervals of a distance similar to the marching distances between companies of soldiers. At the proper time the belt is set in motion by means of a stage hand turning the handle attached to one of the rollers. The effect from the front is that of an army in passing—the bayonets showing over the top of the wall without any of the mechanism showing. To heighten the effect, a flag may be carried across the stage in back of the line of bayonets by another stage hand. Each company or each battalion may thus be designated by the passing of the same stage hand with a suitable flag.

With a fife and drum corps playing behind the wall and the glistening bayonets passing as would company after company of soldiers with flags flying, the illusion is well-nigh perfect.

GRADES OF SAND AND PEBBLES

The handling of sand and pebbles for industrial purposes is a great industry in many parts of the country, and especially in New Jersey, where it is handled by great plants that are as complete in their way as a plant for the production of more precious substances of the earth's formation.

The illustration shows the various grades of sand and pebble screenings of a modern sand plant. No. 1 shows the largest size pebbles, after the shell and rubbish deposit has been removed; No. 2 is the next grade, and so on down to No. 9, the finest grade of sand. The



Product of a Sand Plant

numbers are given in the order of the screening, but when designated for the market the finest grade of sand is known as No. 0, and so on up to No.

8, which is marked as No. 1 in the illustration.

The different grades of sand are used for concrete and building construction, purification of water and sewerage, for iron molding, in the sand blast process of cleaning castings, and for many other purposes.

MISSISSIPPI RIVER TO BE SHIFTED BODILY AT ST. PAUL

The Mississippi river, according to the plans of St. Paul engineers, is to be lifted bodily from its ancient bed in that city at a cost of $3,500,000. Just below the center of St. Paul the river describes a great curve, directly across which the new channel will be cut. This will make new land of the old bed, which, when filled up, will provide an area equal to 700 ordinary city blocks for new growth.

The sides of the new channel, if the present plans are carried out, will be lined with concrete, and parallel slips will be provided near the center of the city for the future river traffic. It is estimated that the task will take several years, but the land thus gained from the river will be of the greatest value to St. Paul, while the land through which the new channel will run is now of but little value. It is the cheapness of the land to be converted into river that accounts for the comparatively small estimated cost of the project.

An Auto Chemical and Hose Truck

AUTO FIRE APPARATUS IN CALIFORNIA

A number of the cities of Southern California have adopted auto fire-fighting apparatus and found this type of machine very economical and reliable, as well as far speedier than the horse-drawn vehicles. The accompanying illustration is an auto chemical fire truck used by the city of Pomona. It carries, in addition to the chemical apparatus and hose, several hundred feet of standard hose, and thereby becomes a hose truck as well as chemical engine. San Diego has the same kind of a machine.

The 4,725 tons of coal burned by the "Lusitania" on a record trip across the Atlantic would be fuel enough to keep ten families warm all their lives.

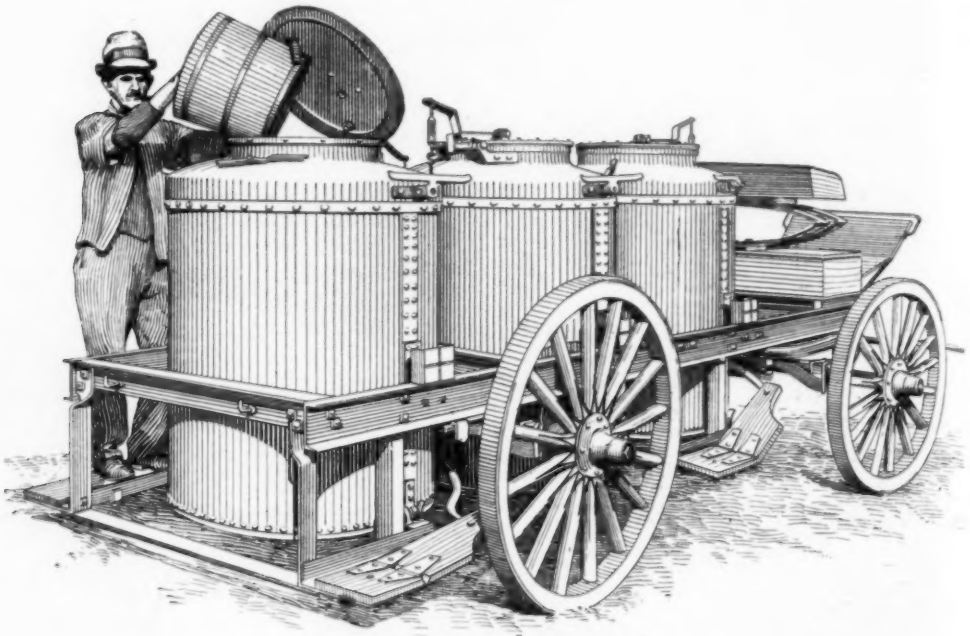
BOSTON HAS ODORLESS GARBAGE WAGON

One of the greatest sanitary problems with which a large city has to cope is the handling and disposal of its garbage. That the open or semi-open wagon is a transmitter of disease is becoming so well realized that many cities are experimenting with a view to improving their garbage-carrying systems, and among these is Boston.

E. S. Dorr, chief engineer of the Boston sewer department, and Guy C. Emerson, superintendent of streets, have been instrumental in the construction of an odorless garbage wagon, one of which is now in use. The wagon consists of a steel frame on four wheels, containing three cylindrical tanks which rest upon trunnions. In form, the tanks are somewhat like milk cans, greatly enlarged, each tank having a capacity of one ton of garbage. To the lid of each is attached a lever, which, in turn, is connected by a chain with a hinged portion of the footboard, resembling a treadle, upon which the men stand to empty their pails. As the attendant steps upon this treadle, his weight raises the cover, and when he steps off after emptying his load, the released lever pulls the lid down again. The load being divided into three parts, only one-third is exposed at a time, and then only momentarily.

When the tanks are full the lids are disconnected from the footboards and the levers thrown over across the lids and locked. Upon the arrival of the wagon at its place of disposal, it is run under a derrick and the tanks are lifted out one by one and dumped; or, if desired, the tanks can be loaded onto the barges that carry the garbage to the plant on Spectacle island, their places in the wagon frame being filled by empty tanks. This process eliminates the objectionable feature of taking the refuse to the island in an exposed condition, on account of which suits to the amount of $400,000 for damages are now pending against the city.

Every part of the wagon, except the spokes of the wheels, is of metal, which



Garbage Wagon with Removable Tanks

allows of its washing with a hose, hot water being used if desired.

COMBINATION ICE AND ROLLER SKATES

Converting ice skates into roller skates without ruining them for the former purpose is shown in this illustration. Holes are bored through the front and back parts of the blades, and through these are inserted wheel-bearing axles in such manner that they clamp firmly in place. After the transformation has once been made it can be repeated at any time in a few minutes. Thus it is possible to roller-skate to the ice rinks, remove the rollers and axles on arriving there, and use the same pair of skates for ice-skating. The extended foot in the illustration is shod with an ice skate provided with

Convenient Skates

rollers, and the other foot bears the skate in its ordinary form.

WOMEN AEROPLANE ENTHUSIASTS

At the close of the Rheims aviation week, French aeroplane manufacturers received many applications from women, including some Americans, who were anxious to learn aerial flight in aeroplanes. At present there are a score of continental women taking first

First Woman to Fly in America

lessons in the science, one of whom is Mme. Presta, who attracted attention at the Italian aviation meet by her costume of knickerbockers, puttees, and Norfolk jacket.

"Some poor creatures," says Mme. Presta, "lack pluck and their nerves seem to bother them, but I don't believe women would be in the least frightened by flight in an aeroplane. I think that in this respect we would acquit ourselves as well as men."

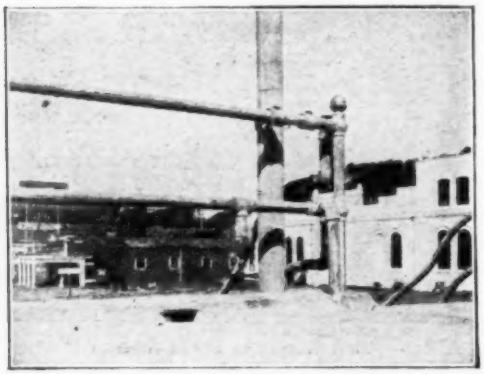
The first woman to fly in an aeroplane in America was the wife of Capt. De Ralph C. Van Deman, of the United States army. She occupied the passenger's seat beside Wilbur Wright in one of the army aeroplane flights on Oct. 27, 1909.

"Now I know why the birds sing when they can fly through the air," said Mrs. Van Deman after her flight. "I know of no sensation to compare with it. I expect to buy an aeroplane, and Mr. Wright will teach me how to operate it. Then I shall fly—fly—fly. Oh, there is nothing so satisfying as flying."

Suffocation of an elevator workman in a grain chute resulted in the coroner of Toledo, Ohio, recommending that the mouth of every chute be protected by an iron grating, a simple and reasonable requirement.

GUARD RAILING CARRIES WATER SUPPLY

This iron railing, which runs from end to end of the reinforced concrete



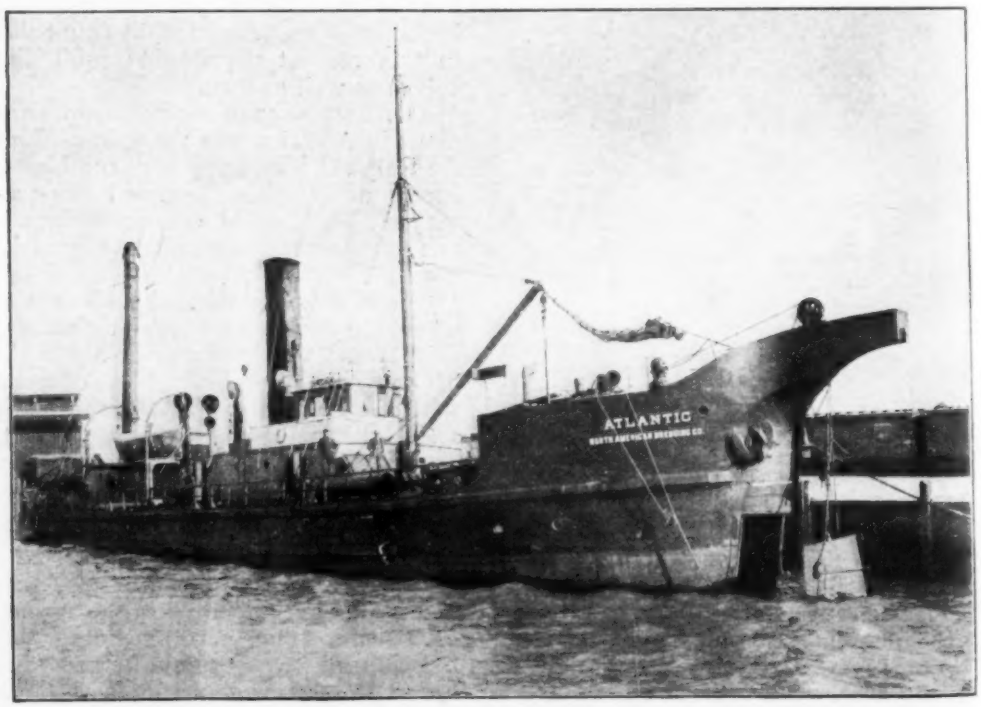
Railing Serves Two Purposes

pier at Santa Monica, Cal., a distance of 1,600 ft., serves a two-fold purpose. While both hollow iron pipes form a protecting fence to prevent persons from falling into the sea, the lower one carries the water that supplies the drinking fountains, wash-rooms, and toilet accommodations conveniently located at different points along the pier.

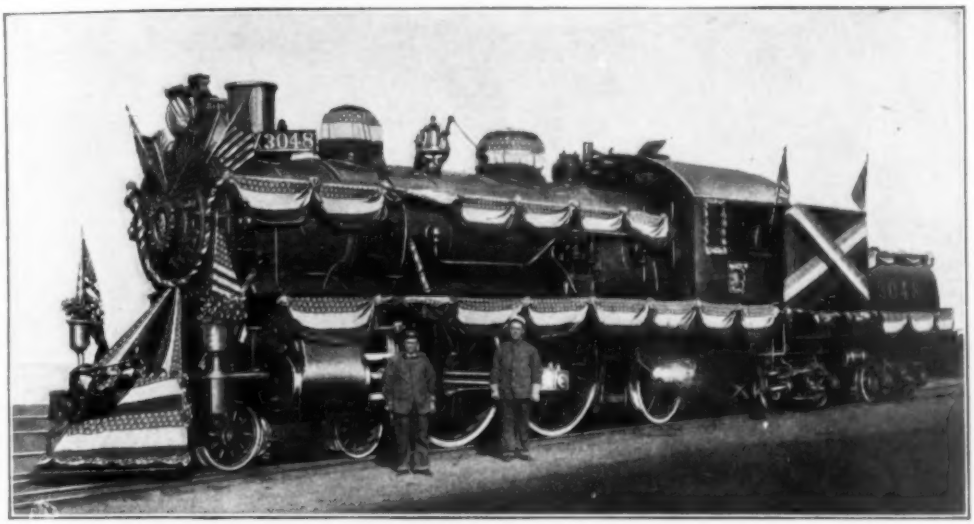
VESSEL WITH DETACHABLE BOW PIECE

The vessel shown in the illustration is a sea-going dredge of curious design. Her somewhat extraordinary nose forms a supporting arm by which the detachable bow piece is removed from or placed in its natural position. When steaming from port to port the bow plate is fastened over the opening, thus making the lower part of the bow appear like that of an ordinary ship. The opening is for the passage of the dredging head to the bottom.

The dredge is being used in the task of filling the grade-raising canal at Galveston. She dug her way into the flats east of the city, a distance of more than 2,000 ft., from the sea wall, and from that point pumps sand filling through pipes to the canal.



A Dredge of Unique Shape



President Taft's California Engine

PRESIDENT TAFT'S ENGINE ON SOUTHERN PACIFIC

This patriotically bedecked engine is the Southern Pacific monster that rushed President Taft through part of his trip in the west. The photograph was taken at San Pedro, Cal., and shows Engineer Dillie and Fireman Faber, as well as the engine. The engineer, who is the little man nearest the head of the engine, is one of the oldest (in point of service) and most careful on the road.

In addition to the flags and streamers, pictures of President Taft were placed on the engine's head and on both sides of the cab.

A NEW SCOTTISH RITE CATHEDRAL

The Scottish rite cathedral of the Masonic order at Ft. Wayne, Ind., dedicated on Nov. 17, 1909, is said to be the largest and most costly in the United States, and one of the finest in the world. Complete with furnishings, it cost $200,000. The marble shafts on each side of the entrance are rather curious, as shown in the illustration, resembling to some extent monumental shafts so often seen in cemeteries.

Samuel C. Lawrence, of Boston, the highest Mason in the United States, was prevented from taking charge of the dedicatory service, and this mission

Finest Scottish Rite Cathedral in America

was filled by Barton Smith, of Toledo, the second highest Mason in this country.

The soya bean of China has entered into competition in Europe with the American cotton-seed products.

Merry-Making in Friesland

A FESTIVAL ON SLEDS

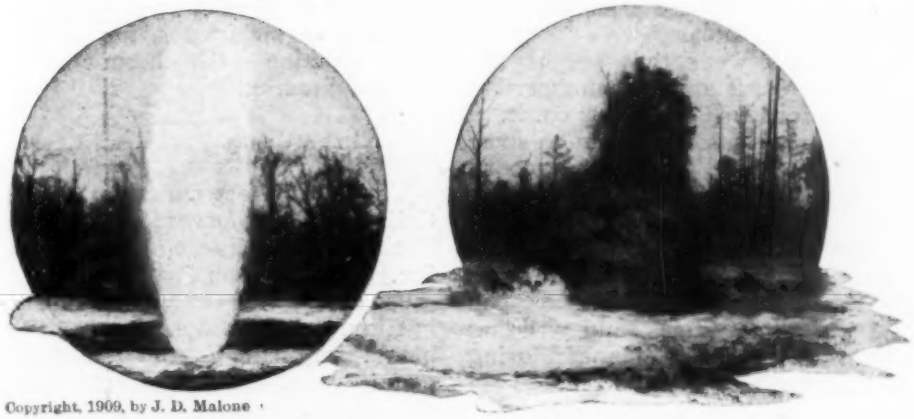
Charming old-world ice festivals are held every winter at Hindeloopen, Friesland, Holland. The Frisians are a people by themselves, are very conservative, speak a peculiar language, and do little to modernize their old-world costumes. The women, like all Hollanders, wear vivid colors, as is shown in the cover design of this issue. Sitting demurely on their sleds, they are waiting for the signal to start a race across the ice, the pikes in their hands being used for propulsion.

A new record for wireless on the Pacific was made recently when a message was received in San Francisco from a steamer at Honolulu, the distance being 2,100 miles.

TWO FAMOUS BURNING GAS WELLS

Two famous burning gas wells, one of which has been in flame for the past four years, while the other is still belching mud, although the flame was quenched many months ago, are the most interesting sights in the Caddo oil field, a tract of land 30 miles long by 15 miles wide near Shreveport, Louisiana.

The first of these has a base 600 ft. in diameter, and is the largest in the field. For four years it has spouted oil, gas, and hot mud to a height of 50 ft. above its crater. It has three outer rims, and the fact that the hot mud overflows and runs like lava into the lowlands has caused it to be called the volcano.



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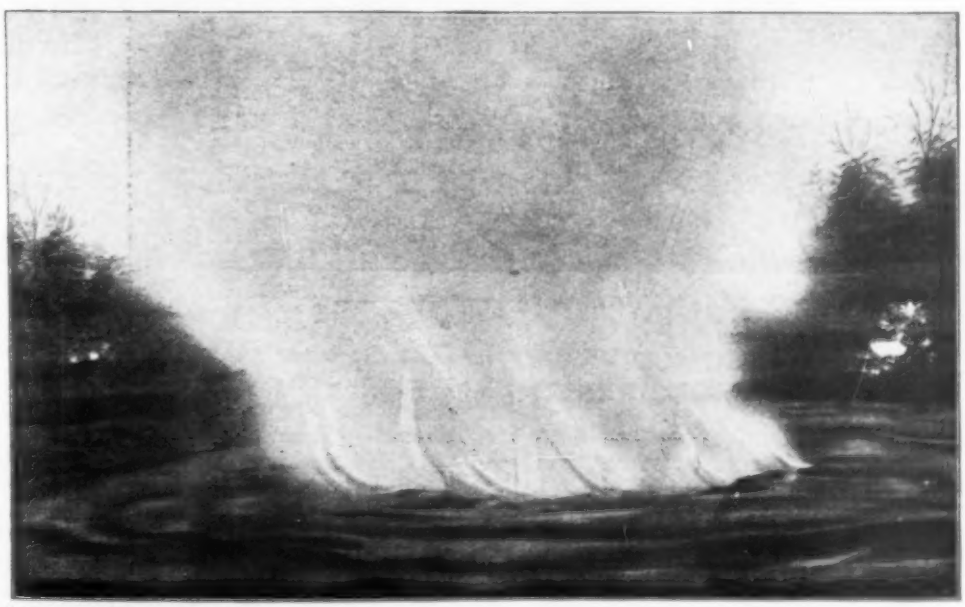
Burning Well Forms Great Gas Jet

Mud Geyser That Took Flames' Place

The other well, of which photographs are shown that were taken before and after the flame was quenched, blew out on June 10, '07. The derrick and piping was completely swallowed up, the workmen barely escaping with their lives. The gas flame that burst from it resembles an immense gas jet, 35 ft. in diameter at the base and widening at the top. It ascended to a height of 125 ft. and continued burning until Feb. 10, 1909, when a terrific wind and rain storm destroyed the well and quenched the flame. The crater was considerably widened by the storm, and this continually vomits a volume of mud that spreads over the lowlands, spouting upwards as high as 50 ft. All attempts to stop this discharge of mud and immense waste of gas have met with failure. Experts believe that the amount of gas that thus escapes from the "wild" wells in the district would furnish light and heat sufficient



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Burning Well That Resembles Volcano

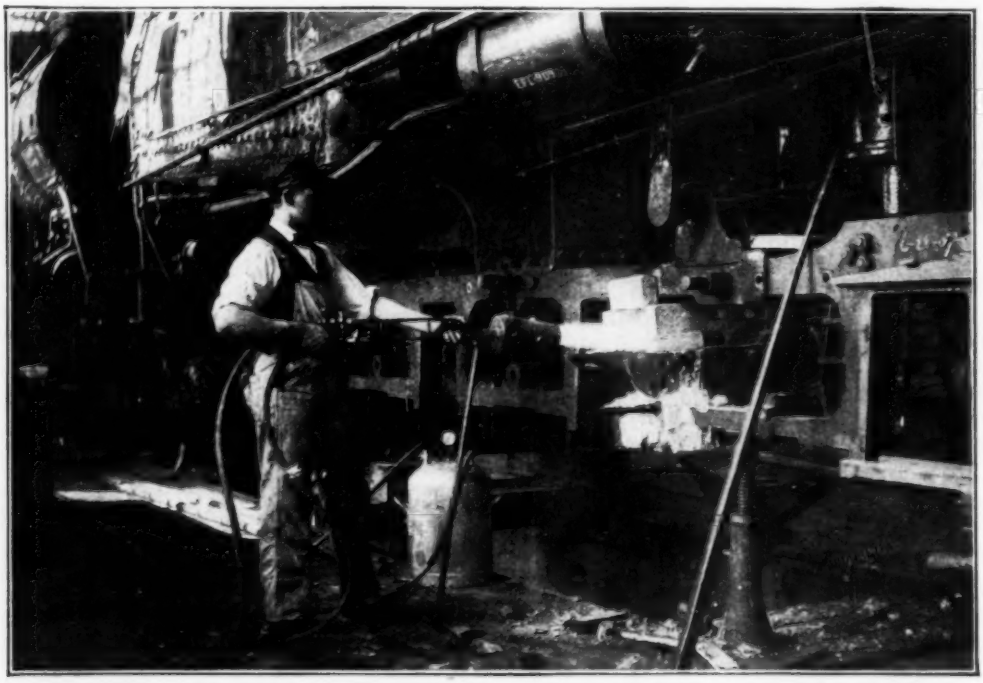
to fill the wants of the principal cities of the United States.

Besides the wells that are beyond control, there are a great number that are said to produce 50,000,000 cu. ft. of gas per day. This is utilized to some extent by piping it to Shreveport, La., Texarkana, Tex., and surrounding towns. A pipe line is also being built to carry the gas to New Orleans, a distance of 300 miles, and branches from this main line will be extended to all the cities, towns, and outlying sugar refineries and manufacturing plants along the route.

repairing steel cars, straightening and welding engine frames, for preheating in connection with thermit welding, and for brazing.

IMMENSE WINERY DESTROYED

The great West winery at Stockton, California, the largest on the entire Pacific coast, was recently destroyed by fire, the loss reaching $750,000. The cause of the fire was spontaneous combustion, and by reason of the inflammable nature of the liquors and the great quantities of oil, it was impossible to



Heating a Locomotive Frame

REPAIRING LOCOMOTIVE WITH HYDRO-CARBON BURNER

A hydro-carbon burner, as used for heating a locomotive frame that requires straightening, is shown in this illustration. The construction of the burner is very simple, and it can be handled safely and with reliable results by any ordinary mechanic.

This type of heater is now used in

fight the blaze successfully. Not less than a million gallons of wines, brandy, and other liquors, was lost, most of it streaming from the immense tanks and vats and running into the ground. For a time the wines were flowing a foot deep into the streets, and hundreds of people, by permission of the company's officials, scooped it up from the gutters in almost every conceivable receptacle and carted it away.

FIREMAN OF FIRST LOCOMOTIVE DIES

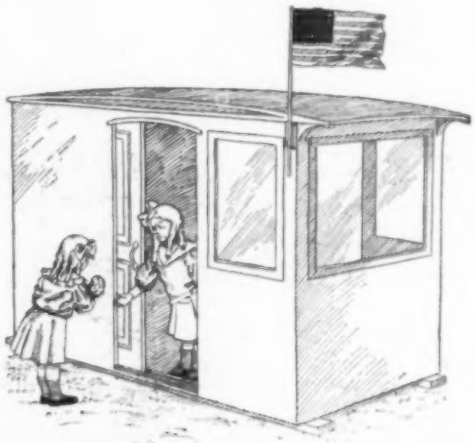
Edward Entwhistle, the fireman of the first locomotive ever built, died recently at his home in Des Moines, Iowa. He was born in England in 1815, and early in life was apprenticed to the Duke of Bridgewater's shops in Manchester, where he helped in the construction of Stephenson's engine. Chosen from hundreds of other young mechanics, Entwhistle, then 16 years old, was selected as fireman and accompanied Stephenson on the famous "Rocket" when it astonished thousands by making the high speed of 12 miles an hour. He later emigrated to the United States, becoming one of the first steamboat engineers on the Hudson river.

NOVEL SEWER-EXCAVATING MACHINE

The interesting feature of this sewer-excavating machine lies in its traction wheels. They are of the type adopted by Capt. Scott for the ice automobile he will use in his dash to the South Pole. The wheels make their own road as the machine advances, the endless chain of blocks that form the outer rim revolving in the direction the machine is traveling. The adoption of the idea for the excavator makes traction possible on ground that otherwise would be too soft to bear the weight of the machine.

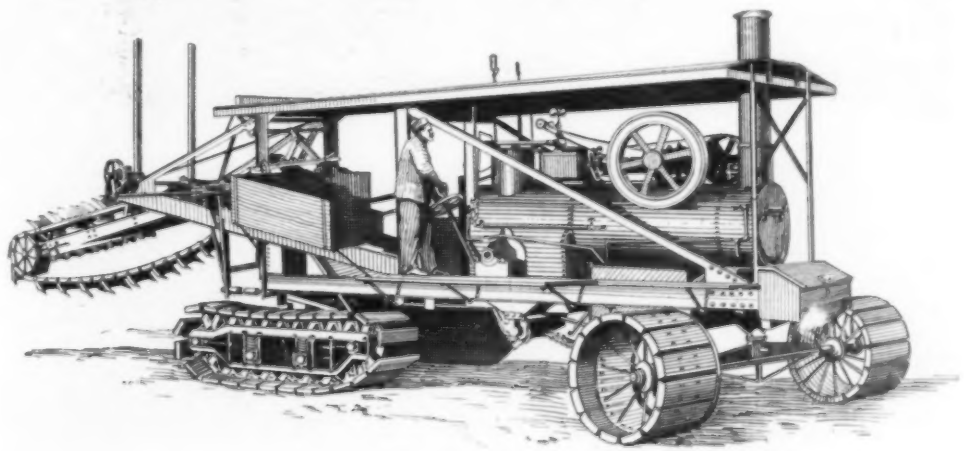
PLAYHOUSE OF MILK-WAGON TOP

A Chicagoan, being anxious to keep his two children within the yard, accomplished his object by erecting this

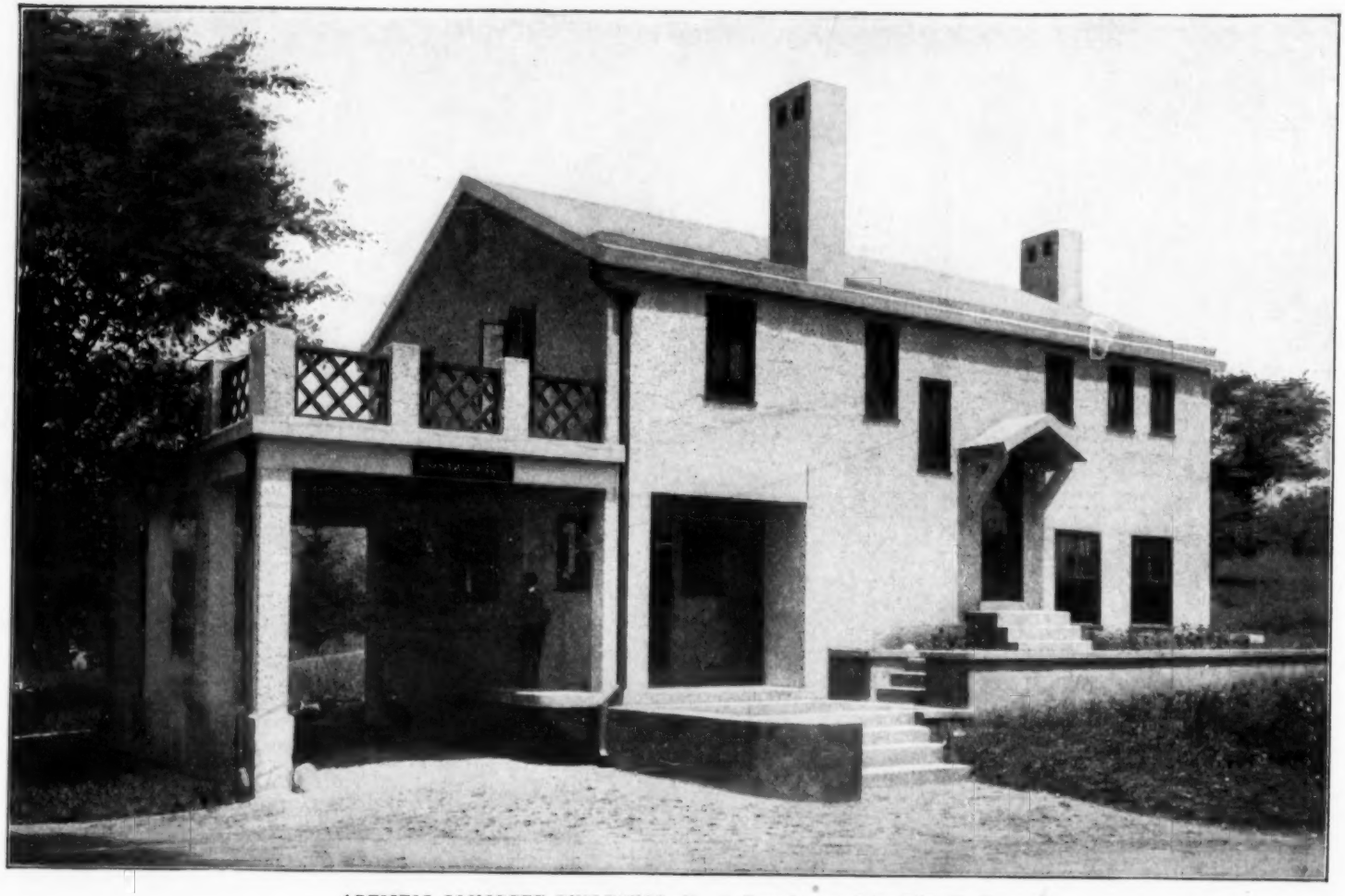


Inexpensive Child's Playhouse

novel playhouse. It is the discarded top of a milk wagon, freshly painted and provided with new glass. One day it is a playhouse and the next a fort, proving excellent for both purposes.



Sewer Excavator Makes Its Own Road



ARTISTIC CONCRETE BUILDINGS—No. 3, Postoffice at Briar Cliff, N. Y.

DIAMONDS SMUGGLED IN CEMENT

Through the arrest of an engineer in Berlin, charged with smuggling $50,000 worth of diamonds into that country from Africa, it developed that his chief accessory was nothing more nor less than ordinary building cement. The stones were mixed in the soft cement, which was afterwards allowed to harden, and the smuggler succeeded in getting these valuable blocks through the customs several times without being detected.

Suspicion was finally directed toward him by his attempts to dispose of the diamonds, and he was constantly watched several months before his method of smuggling was detected.

ALUMINUM AIR-COOLED PIPE

The curious pipe shown in this illustration is made of aluminum and is air-cooled in the same manner as motorcycle and aeroplane engines. The series of rings around the bowl radiate

Patent Air-Cooled Pipe

heat on the same principle as those on the above mentioned gasoline engine.

SHIP WITH PERFORATED SAILS

Some time ago the idea was advanced that if a number of small holes were made in a ship's square-sails, allowing the wind to rush through, the usual accumulation of dead air would be prevented and the sails draw better. Various marine authorities differ as to the value of the idea, many believing that the advantage derived, if any, does not compensate for the inevitable weakening of the sails.

Quite a large number of square-rigged vessels still make use of the idea, however. The accompanying illustration clearly shows the small circular holes in the sails of a vessel entering Puget Sound.

Holes Supposed to Do Away with Dead Air

U. S. ARMY TO DEVISE AERIAL GUNS

Following the example of the European governments, the bureau of ordnance of the U. S. war department is making a series of experimental aerial attacks at the Sandy Hook proving grounds in New Jersey. During the first stages balloons only will be used, but as knowledge is obtained, the field of operation may be extended. The firing will be done with cannon now in use, and such new designs will be drafted as the experiments show may be wise.

The experiments already made in Europe, however, have demonstrated that ordinary field artillery is ineffective against aerial craft.

The annual expenditure for the army and navy is about $230,000,000.

BOILER EXPLOSION AT AYLMER, ONT.

A boiler explosion in the electric light plant of Aylmer, Ont., in October,

The Wrecked Plant—View of Engine and Dynamo Room

killed one person, completely wrecked the plant, set fire to an adjacent factory, and caused more or less damage through the town. The boiler had just been cleaned and filled a few hours before the explosion and had been inspected a month before.

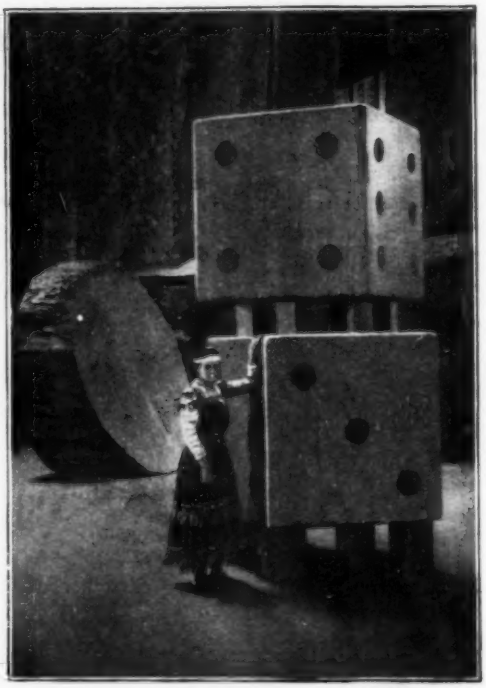
The force of the explosion tore the building to pieces, threw a section of the boiler, weighing over a ton, a distance of several hundred feet, and hurled smaller pieces of metal and brick over a large section. A piece of pipe weighing 125 lb., thrown several hundred feet into the air, descended on the roof of a warehouse and did not cease its fall until it had torn through three floors.

The illustrations show what remained of the boiler room and building after the explosion, and the wreck in the engine and dynamo room.

HUGE DICE IN WONDERFUL FORESTRY BUILDING

In the center of this photograph, which shows a small section of the forestry building at the Alaska-Yukon-Pacific exposition, are what are claimed to be the largest dice in the world. They measure 4½ ft. square, were cut from single blocks of wood, and bear the inscription: "The kind of dice we throw in Washington."

The forestry building was the largest building of its kind ever erected. It was 312 ft. long, 128 ft. wide, and 90 ft. high. In it were 2,016,000 ft. of logs and lumber, and 300,000 cedar shingles. It contained 126 main columns consisting of huge logs with the bark on, ranging from 42 to 54 ft. in height, and from 5 to 6½ ft. in diameter. Some of these columns, which weighed 25 tons or more, are seen in the photograph.



Dice 4½ Ft. Square

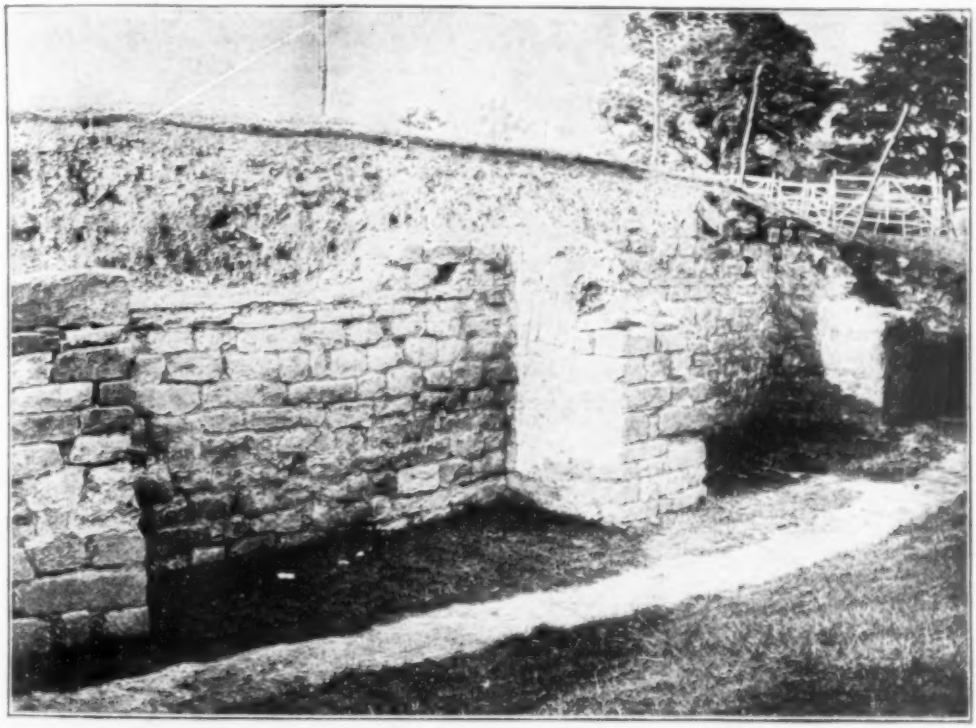
PART OF KING ARTHUR'S AMPHITHEATRE

This photograph shows a section of the amphitheatre in King Arthur's round-table field in Monmouthshire, England. The Archeological society has made five excavations around the walls, and the searchers found the main entrance, the sand which formed the bed of the arena, and a corner stone. From inscriptions on this stone they trace the date of the theater back to 110 A. D., or 1,800 years.

SOME USES OF THE COCOANUT

The cocoanut, a fruit familiar in nearly every part of the world, in one form at least, is used in many ways in the countries of its growth that would surprise the lovers of its milk and meat in this country.

The outside part, or husk, is manufactured into a fiber that forms a splendid material for upholstering purposes and the stuffing of mattresses. For such purposes it is said to equal sea grass, and is much more sanitary than



Wall Built 1,800 Years Ago

MONSTER LEATHER BELT

A monster leather belt, said to be one of the largest ever made, has been shipped from New York to a lumber company at Rogalusa, La. It is 240 ft. long, 6 ft. wide, and into it went the hides of 540 Texas steers. The cost of the belt was $5,800.

The majority of farms in Wisconsin are claimed to have bad water supply.

feathers. The shell, which is the outside of the nut proper, is made into ornaments, which, mounted with gold or silver, are often very pleasing.

The edible part of the nut is prepared in many ways. To form an oil, it is first grated, water is added, and the resultant mass is squeezed or pressed through a strainer until the milky portion is entirely extracted. The fluid is then boiled down to the consistency of oil. Through both the

East and West Indies this oil is used for curative purposes, and, applied ex-

Avenue of Cocoanut Palms

ternally, is the most used remedy for stiff joints, lumbago, etc. When fresh, it is a splendid addition to boiled codfish, an excellent substitute for butter, and is preferred to the finest olive oil by the West Indian Creoles.

The grated meat of the nut is also made into bread and cake, and, with the addition of sugar, delicious jam is produced. Cocoanut pie is claimed to be equal to the best apple pie, and is considered a great luxury.

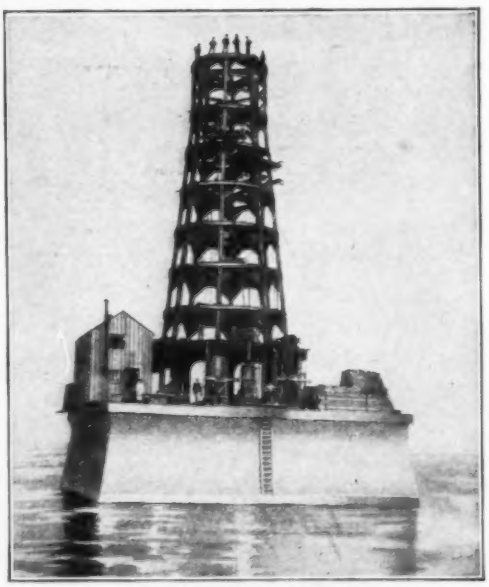
The illustration shows a cocoanut palm avenue in British Guiana.

GREAT LIGHTHOUSE OF STEEL AND CONCRETE

What is to be the largest lighthouse on the Great Lakes has been building for nearly two years on White Shoals, in the Strait of Mackinac about 25 miles from the island of that name, and will take several months more to reach completion. It is not, however, its great size that has attracted attention during its building, but the method of construction, which is something of an innovation.

It rests upon a massive foundation of concrete blocks, and in this does not differ from many other lighthouses on the lakes, but from this foundation rises a great circular steel structure, the parts of which are riveted together in the same manner as is the structural work of a tall metropolitan skyscraper. Around this framework, which is shown in the illustration, the concrete will be placed. The structural steel required was 200 tons, the diameter at the base is 40 ft., tapering to 22 ft. at the apex, and the whole is divided into eight stories, or floors.

Another novel feature is the lantern and lantern deck, which are to be constructed of aluminum, the first of its



Latest Type of Lighthouse

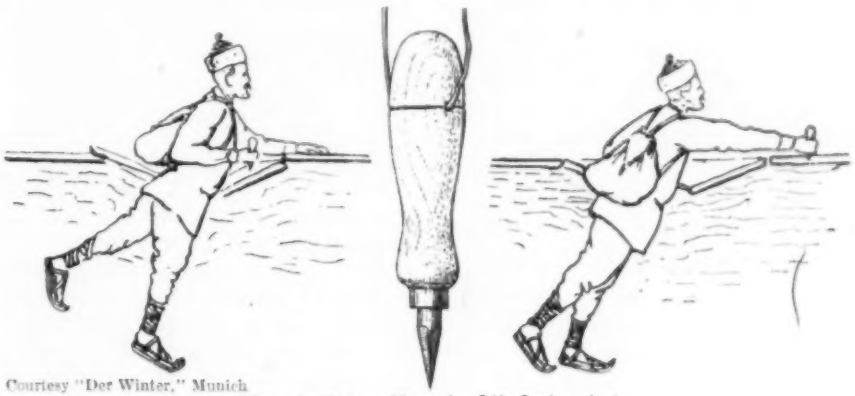
kind on the Great Lakes. The cost of the lighthouse will be more than $250,000.

The geological survey has just completed an investigation of the smoke nuisance in 13 cities.

A LIFE-SAVING AWL FOR SKATERS

Translated from the German by Lewis H. Rose

Considering the many lives lost every year by breaking through, or still oftener by skating into holes in the ice, a simple and very practical means of saving one's self from drowning should be of interest. To the author's knowledge, the "life-saving awl" here shown has long been in use in Holland, Friesland and on the lake of Constance. It is probably in use in other places, but it does not seem to be generally known. It consists simply of a wooden handle, about 4 in. long, in which a strong steel point is firmly fastened. It is carried (preferably two of them) either loosely in the outer coat pocket or on a string slung over the shoulder. As the illustration shows, this awl enables the skater who has broken through to pull himself out.



Courtesy "Der Winter," Munich

How the Skater Uses the Life-Saving Awl

The use of this little tool is as simple as the tool itself, and hardly needs any explanation. The method of rescuing one's self is about as follows:

1. As soon as you break through the ice, extend the arms. Don't get excited!

2. Swim to the edge of the ice from whence you came. Rest one hand on the ice. Gently tread water.

3. Take the awl in the other hand and remove the cork from the point with the teeth. Reach over on the ice as far as possible and plant the point firmly in the surface.

4. By drawing in the arm you can now easily bring the hips on to the ice. Stand up, put the cork back on the point of the awl and skate off.

In this manner it is possible to get back on the ice in twenty or thirty seconds, if one preserves his presence of mind and acts with reasonable deliberation. Do not waste your strength in useless floundering or swimming in different directions. The ice over which you have skated is the only part you know to be thick enough to bear you. The water under the ice is not in the least cold. When the air is at say 10° Fahrenheit the water will feel almost lukewarm. If leggings be worn or the long trousers be tied around the ankles, one can easily swim for the few seconds necessary, as the enclosed air exerts considerable buoyancy. [European winter sportsmen very generally wear ankle trousers strapped around the bottom.—Translator.] When one gets one hand on the edge of the ice he can easily raise his head and shoulders out of the water, as shown in cut. The person using this awl for the first time will be surprised at the ease with which he can rescue himself. If the ice breaks when you first try to draw yourself up on it, which will seldom happen except on very new ice, plant the awl in the ice beyond where it has broken; and if necessary, repeat the operation

until you reach ice firm enough to hold you. If the ice all around you be so thin that you can not get into a sitting posture on it, it will often hold you while lying down. In such a case, pull yourself, while lying flat on the abdomen, over on to firm ice. This can be done with one awl, but a second one will here greatly expedite matters.

It need scarcely be mentioned that a moderate amount of exercise will keep one comfortably warm in cold weather, even after one is wet. In a few seconds the shoes and outer clothing freeze to an impervious protecting coat, while the water in the hosiery and underclothing quickly assumes the temperature of the body. The wet gloves act in the same manner, and therefore should not be removed. One can, if necessary, remain out of doors for hours in this condition without serious discomfort.

FELLING TREES WITH CIRCULAR MOTOR-DRIVEN SAW

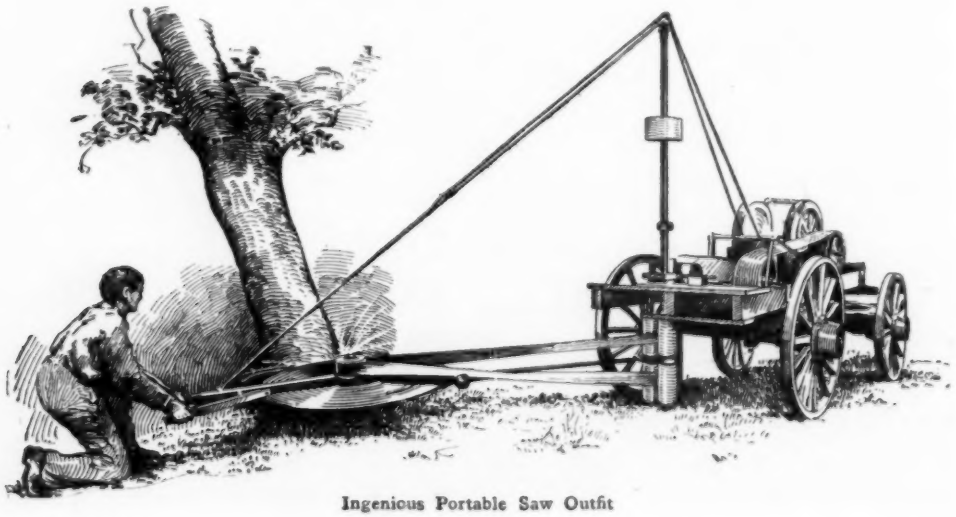
This illustration gives an excellent idea of an ingenious arrangement of a circular saw and gasoline engine to be used for cutting down trees. All the units of the plant are assembled on an ordinary farm wagon, the saw being arranged on a mast which swings from the back end of the vehicle. The gasoline engine belt is connected to a horizontal shaft, which in turn is connected to a perpendicular one. A belt leading from the perpendicular shaft whirls the saw, which can be raised or lowered to satisfy the requirements of height. As shown in the illustration, the saw can be made to cut very close to the ground, which is a distinct advantage.

NEW PLANT LIGHTS AND HEATS THE CAPITOL

The great power plant on which the government has expended $1,500,000 to provide light, heat, and power to the capitol, the congressional library, the senate and house office buildings, and the coast and geodetic survey buildings, is now practically complete. The plant stands on the site of old Garfield park, about 3,500 ft. from the capitol and still further from the senate office building, but the engineers do not expect much lost heat in the long journey of the steam.

The plant itself, aside from the powerful machinery it contains, is large. Twin smokestacks tower 212 ft. into the air, the boiler-room, containing sixteen 600-hp. boilers, is 160 ft. long and 87 ft. wide, and the turbine room is 112 ft. long by 85 ft. wide.

The saving of coal by this central plant will be great. It is estimated



Ingenious Portable Saw Outfit

that the capitol has used from 7,000 to 10,000 tons each year, according to the weather conditions and length of the session; the library used from 4,000 to 5,000 tons, and the other buildings also used a heavy amount. The new plant, it is believed, can be run for from $20,000 to $25,000.

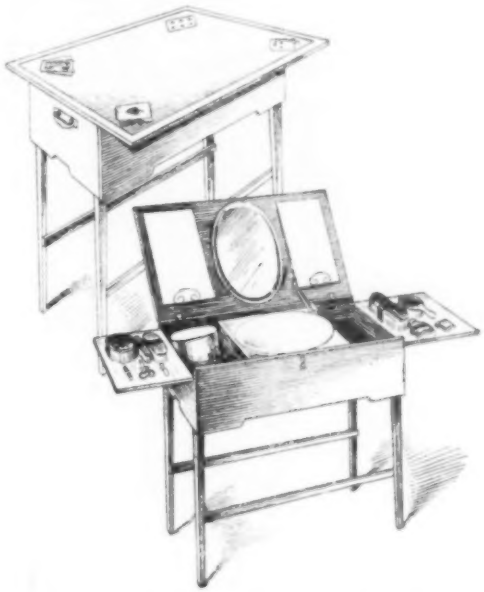
The system by which the light and heat are transmitted to the buildings includes 6,000 ft. of tunnel, 7 ft. high by 4½ ft. wide. The steam pipes are arranged along one side, and the electric current for light and power is carried by conduits, which run parallel with the steam tunnels. In the tunnels is ample room for sidewalks, and the lighting system is such that the workmen or inspectors traversing them can turn them off and on before and behind as they progress.

CANADA'S GREAT WATER POWER

The water power of Canada is estimated by E. R. Young, superintendent of railway lands, at 25,000,000 hp., which, if evenly distributed, would furnish every man, woman, and child in Canada today with between three and four horsepower. The report, which is considered conservative, gives Quebec 17,000,000 hp., of which 9,000,000 hp. is concentrated in the wonderful Hamilton falls, estimated as capable of developing anywhere from three to five times as much power as Niagara. Ontario is given 3,000,000 hp.; British Columbia 2,000,000 hp., Alberta, 1,000,000 hp., with the remainder about equally divided among the other provinces.

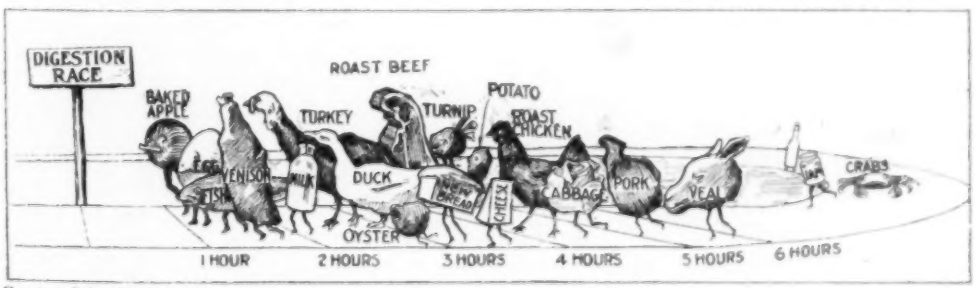
FOLDING TOILET AND CARD TABLE FOR AUTOS

The combination card and toilet table shown in these illustrations is



Combined Collapsible Toilet and Card Table

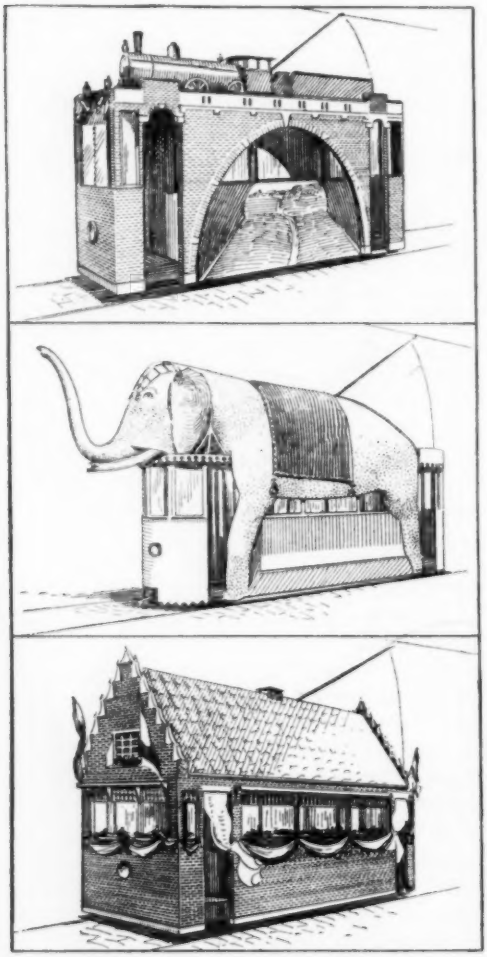
an interesting automobile accessory manufactured in England. It has a double top, the upper one being used for cards. When this is lifted a toilet table is disclosed, with side flaps containing brushes, combs, etc., a basin, two water tanks with over a gallon of water capacity, towels, looking-glass, etc. All the metal parts are of aluminum, and when wanted out of the way, the legs collapse, the result being a neat, compact box that can be strapped to the step or other storage place.



Courtesy Scientific American

INGENIOUS DUTCH STREET-CAR FLOATS

The birthday of Queen Wilhelmina, of Holland, was celebrated at the Hague by a great pageant in which the street-car floats were an interesting feature. Street cars, or trams, as they are known in Europe, were converted into representation floats of many kinds by the erecting of canvas buildings, animals, etc., about them.



Celebrating Queen Wilhelmina's Birthday

The illustrations show three of the most interesting, one of them being a railroad station with a locomotive on top, while the other two are a Dutch house and an elephant.

A WESTERN YANKEE

An enterprising Yankee from the Granite hills of New Hampshire, went out to Montana last summer with his brother who had been living at Spokane for twenty years. The old New Englander was the guest of his western kinsman and while his traveling expenses were paid for him, went rather grudgingly. All the way he made unfavorable comments on the scenery and farms and conditions generally. The barns and houses were small; there weren't any trees. It was too far from Boston; the soil looked poor from the car window; the towns were new and raw and the absence of rocks and history made him very peevish.

He stopped off at several points to look over the country and one of these was at Valier, Montana, where a new irrigation system was being established under the provisions of the Carey Act which provides that the Government furnish the land, the State hire a contractor to build the dam, canals, ditches, etc., and the settler, if he is a citizen of the United States, file on 40 to 160 acres, paying back to the State the proportionate cost of putting in the water works plus fifty cents an acre for the land. The idea of getting virgin soil which had never been cropped for fifty cents an acre and a perpetual water right at cost, struck the keen old Yankee right where he lived. Grass land with neither sage brush, rocks nor stumps, that would grow 45 bu. of wheat per acre looked good to him. He filed on 160 acres, paying $3.50 per acre down and agreed to pay the balance during a period of 14 years.

Now here comes the joke: Adjacent to this irrigated land was considerable high land which could not be watered. Much of it was but a few feet "above the ditch" yet on that account it could be obtained for a nominal sum. The old Yankee had analyses of the soil made and found it extremely rich in phosphates, nitrogen and potassium. In fact it was almost as high in these elements as some of the fertilizers he and his New Hampshire neighbors had been buying to put on their barren

soil in order to keep up the fertility of that section where abandoned farms give easterners so much concern. He devised a scheme for skimming off the tops of the high points, shipping the stuff east for fertilizer.

As the intermountain soil in those valleys is 80 ft. deep, he had enough left to last forever and the surface was lowered sufficiently so that he could put in ditches and irrigate the whole tract. To thus secure irrigated land for fifty cents to ten dollars per acre and sell off the high spots as a by-product, remained for a shrewd Yankee who, like the sinner of old, "came to scoff but remained to pray."

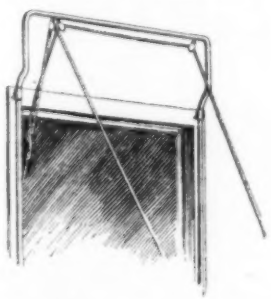
STOPPAGE OF AEROPLANE MOTOR NOT DISASTROUS

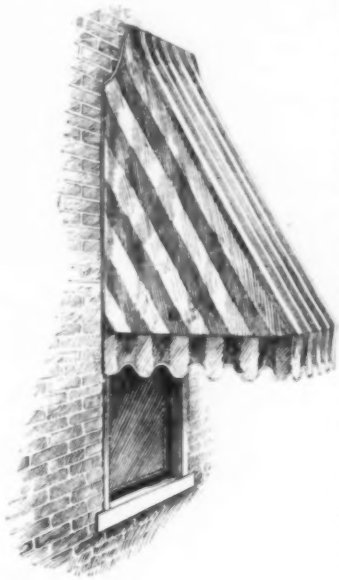
That the stoppage of the motor when an aeroplane is high in flight is not necessarily disastrous was demonstrated by Wilbur Wright at College Park, Md., on Oct. 25. He rose to a height of 150 ft., then shut off his engine and began to glide earthward. He landed without mishap in approximately 13 seconds.

The general public and many writers have held the idea that should the motor stop, as even the best gasoline engines often do without apparent reason, the aviator would fall to earth, receiving serious, if not fatal, injuries.

VENTILATED AWNINGS FOR HOUSE WINDOWS

Conceiving that the ordinary awnings over residence windows necessarily keep out a considerable amount of air as well as the rays of the sun, an awning concern has now designed the awning shown in the illustration. At the top is an opening which extends about 12 in. above the window and is about 3 in. out from the wall. This makes a perfect flue and the heat naturally rises and passes out through it, allowing cooler air to enter through the bottom.

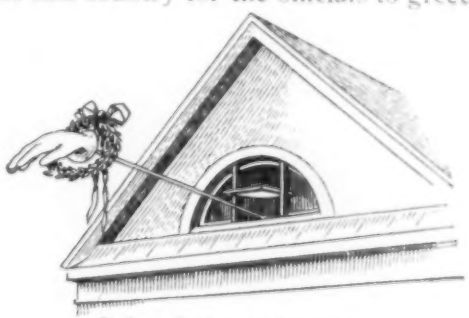




The illustration shows an awning in position and the framework by which the top is left open.

"LOCKING UP" THE POLICE

It is customary in many of the cities of this country for the officials to greet conventions or visiting delegations by figuratively turning over to them the keys of the city. Attending this ceremony is usually some such jocular remark as "we will lock up the police while you are here."

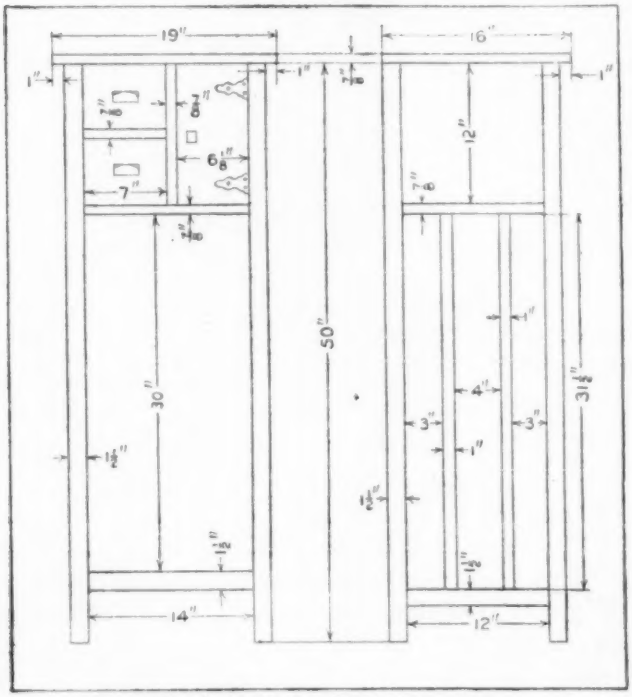


Curious Custom in Barnstable

During the annual fair at Barnstable, England, this intelligence is conveyed to the people by hanging a white glove out of an upper window of the police court on a stick. During the time it is exhibited no one can be locked up, a peculiar custom many centuries old.

HOW TO MAKE A MISSION SHAVING STAND

This attractive and useful piece of mission furniture will be appreciated by the person that does his own shaving. The shaving stand can be made at home by a handy man in his spare time as the stock can be ordered from a mill ready for making the joints and attaching the few pieces of hardware. The following is a stock list of materials:



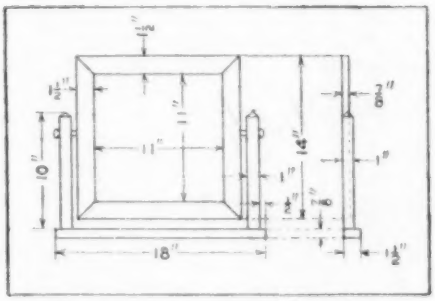
Details of Shaving Stand Construction

4 posts 1½ in. square by 50½ in.
4 slats ⅞ by 1 by 32½ in.
2 cross rails 1 by 1½ by 15 in.
2 end rails 1 by 1½ by 13 in.
1 top ⅞ by 16½ by 19½ in.
1 bottom ⅞ by 15 by 17 in.
2 ends ⅞ by 12½ in. square.
1 back ⅞ by 12½ by 14½ in.
1 door ⅞ by 6½ by 12½ in.
2 drawer ends ⅞ by 6 by 7½ in.
1 partition ⅞ by 12 by 14 in.
1 partition ⅞ by 7 by 14 in.
7 pieces of soft wood ½ by 7½ by 12 in.
2 posts 1 in. square by 10½ in.
1 bottom piece ⅞ by 1½ by 18½ in.
4 mirror frame pieces ⅞ by 1½ by 14½ in.
2 sticks for pins.
2 hinges
1 lock
2 drawer pulls.
1 beveled glass mirror 11½ by 11½ in.

While this piece of furniture can be made in any kind of wood, the novice will find that quarter-sawed oak will work up and finish better than the other woods. The stock list given has dimensions ½ in. larger in some instances for dressing and squaring where necessary.

The tenons and mortises are first cut for the cross-pieces at the bottom of the posts, and, as it is best to use dowels at the top, holes are bored in the bottom piece and also the ends of the slats for pins. The bottom piece is also fastened to the posts with dowels. The bottom must have a square piece cut out from each corner almost the same size as the posts. When setting the sides together the end board and posts can be doweled and glued together and after drying well the posts can be spread apart far enough to insert the bottom rail and two slats. The rail and slats should be tried for a fit before putting on any glue which may save some trouble.

After the sides are put together the back is put in and glued. The top is then put on and fastened with cleats from the inside. The partitions are put



Mirror Frame and Standards Details

in as shown and the door fitted. Two drawers are made from the ends and the soft wood material. The drawer ends may be supplied with wood pulls of the same material or matched with metal the same as used for the hinges and lock.

The pieces for the mirror frame must be rabbeted ½ in. deep to take the glass and the ends joined together with a miter at each corner. The two short posts are tenoned and mortises cut in the bottom piece for joints and these joints well glued together. The bottom piece is then fastened to the top board of the stand. This will form the standards in which to swing the mirror and its frame. This is done with two pins

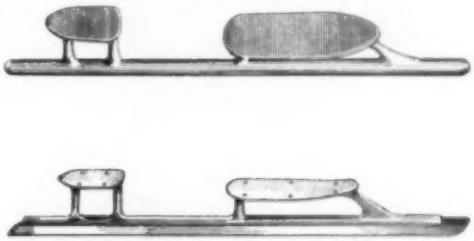
Shaving Stand Complete

inserted in holes bored through the standards and into the mirror frame.

After the parts are all put together, cleaned and sandpapered, the stand is ready for the finish which can be made in any color desired by selecting the proper mission stain.

SKATE BODIES OF ALUMINUM

Additional lightness without loss of strength has given aluminum a place in



Skates of Aluminum and Steel

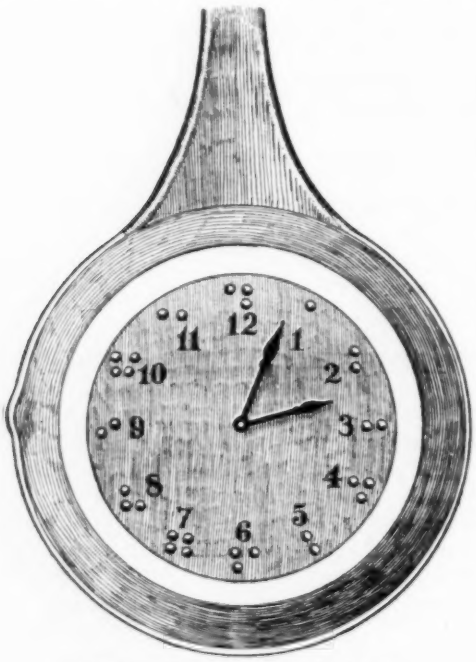
the manufacture of skates, a concern in Cleveland making skate bodies of this metal. A blade of steel about ⅝ in. wide and 1/16 in. thick is inserted in the aluminum. The illustrations show such a body before finishing, and a completed skate with blade in position.

MOTORBOATS IN WARFARE

By a special arrangement with the yacht club at Worthersee, the Austro-Hungarian war office held a series of maneuvers with motorboats to determine just what their usefulness would be in time of war. A fleet of 12 boats of the club, under the personal supervision of Major-General von Hess, took part, and received orders to transport as rapidly as possible a body of engineers, covered by a company of infantry and a machine gun, to a point on the shore whence they could most conveniently reach a railroad bridge to be blown up to retard the advance of the enemy. An open boat carried the machine gun and gunners, and within a short time the bridge was technically destroyed and the whole flotilla had made a safe retreat. The general expressed his entire satisfaction with the manner in which the operations were executed, and devised more tests for a later date.

FRYING-PAN CLOCK FOR THE BLIND

The clock shown in this illustration is a rather ingenious assembling of an



Has Braille Figures for the Blind

ordinary alarm clock minus its case, a discarded frying pan, and a circular sheet of copper, to form a time-piece by which the blind can tell the exact time. The copper sheet is the dial and upon it are stamped the dots which form the numbers of the Braille system of letters and figures. It was made in the Missouri school for the blind.—Contributed by R. Parker.

QUICK METHOD OF LACQUERING BRASS

By a new method of lacquering brass for bedsteads, the tubes are placed on a lathe and electrically heated, the entire process requiring only from 45 seconds to two minutes, depending upon the size of the tubes and number of coatings desired. Unlike the old method, the lacquering and heating is one continuous method. The tubes, while rotating on the lathe, are being electrically heated, and the lacquer dries as rapidly as it is put on, necessitating no wait whatever between coats.

Besides the shortening of the time required, which is a tremendous saving, the new process does not require a temperature of more than 288 deg. F., consequently the color of the lacquer does not suffer; there is no waste in heat, and an economy of space is effected by the doing away with the ovens.

The old method of heating the tubes in an oven for from 10 to 30 minutes between each application of lacquer required a period of from one to one and one-half hours for finishing a tube, depending upon the size of tube and coats required.

CIGAR-SMOKING MACHINE

The curious apparatus here illustrated is a cigar-smoking device used at the Department of Agriculture at Washington to test the burning qualities of cigars. The smoking is accomplished by allowing the water in the glass vessel at the left to escape gradually through tubes. This movement of water creates a vacuum, and

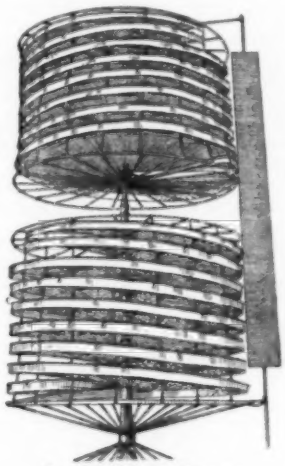
Machine Smokes Four Cigars at a Time

as the air is sucked into the vacant part of the vessel the suction causes

a pull on the cigars, four of which are smoked at a time. The action is exactly the same as when a smoker draws air through a cigar by puffing.

SPIRAL SCREW HELICOPTER

The flying-machine partially shown in this illustration is the invention of an Englishman and is drawing considerable attention in that country. As yet it has not flown, but, from the tests made, several English experts believe that with an improved design and better disposition of the surfaces it will fly under a greater wind velocity



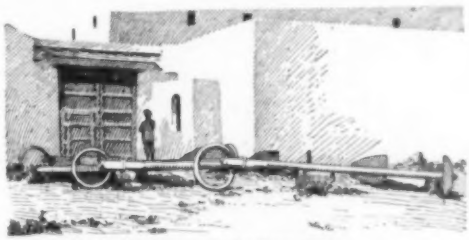
An English Helicopter

than is now possible with the present type of aeroplane.

The lifting surface consists of twin screws of a spiral design spinning inversely on a vertical shaft. Each screw is 10 ft. in diameter, with a total area of 900 sq. ft., the whole machine weighing 1,190 lb. It is expected to lift over 3,000 lb., on a basis of 3½ lb. to the square foot, with 50 hp.

ANCHORS SUPPOSED TO HAVE BEEN NOAH'S

In Tunis are three very ancient anchors, the origin of which is totally unknown. In such countries an ancient object cannot possibly exist without some kind of history, authentic or mythical, therefore these anchors, according to an Arab legend, were used in Noah's ark. The legend also in-



Anchors of Ancient Times

sists that after the flood they were miraculously transported to Kairouan, the Holy City of Tunisia.

DRAINAGE SYSTEM OF PANAMA CANAL

The first thorough tests of the recently completed drainage system of Culebra cut was caused by a rainfall of about 4½ in. on the afternoon of Oct. 1, most of this great fall occurring between 12 and 1 o'clock, noon.

The system divides the cut into two slopes with the summit, at present, at Empire. All the water that collects between this point and the Pacific end of the cut at Pedro Miguel flows through the ditch in the center, and thence in a division ditch to the Rio Grande. All that collects between the summit and the Atlantic end flows into a sump at Bas Obispo and is raised over a dike into the Chagres river by three 22-in. pumps.

After the rainfall on Oct. 1 the water in the Bas Obispo sump stood 51 ft. above sea level, which was higher than the water in the Chagres river at that time. The pumps were flooded, all the steam shovels were out of commission, and viewed from that point the situation appeared one that would require days to remedy. The gates between the sump and the Chagres river were opened, and the water was thus lowered until the pumps could be operated. All night long the pumps poured their capacity streams, 15,000 gal. per minute, into the river, and by noon of the day following the rainfall the steam shovels were again at work.

PROTECTING BRIDGE WITH SPRINKLERS

A wooden trestle on the Klamath Lake railroad in Oregon is protected from fire in the dry season by a system of sprinklers which keep it continually wet. A pipe runs the entire length of the trestle between the tracks, and at short distances are holes through which the water is sprayed over the structure.

Continual Sprinkling of Railroad Trestle

SKINS OF RATS ARE MARKETABLE

An impetus to the war of extermination of the brown rat, now being waged by the governments of many countries, including the United States government, as well as some of the Pacific states, may result from the fact that the skins of the rodents are marketable. Already, the traffic in this commodity amounts to more than a quarter of a million dollars annually in England. Such a trade is now being developed on a large basis in Calcutta, and in all probability it will also develop in the United States.

It has been found that the skin of this rodent is well adapted to a variety of purposes, such as the binding of books, and the making of purses, gloves, and other articles of use and adornment. To secure the most perfect skins, the rats should be trapped or dispatched by other means than by virus, as the peculiar eruptive effects of this means of killing depreciates the value of the skin.

BREAD MADE DIRECT FROM WHEAT

There has been a tendency for some time in certain businesses to do away with the middle man, but bread direct from wheat, with the necessity of first converting it into flour done away with, is an exceptional instance of attempting to do away with a middle process.

The idea is that of a concern in Paris, and the machine developed by them transforms the wheat into dough by the following means: The machine consists mainly of a large screw turning loosely in a case on whose inner surface is a screw thread running in the opposite direction. Between the main threads on the cylinder are smaller threads, and the depth of the groove between the main threads grows progressively smaller from one end to the other, so that it will hold the entire wheat grain, as it enters the machine, and will accommodate only the pulverized wheat at the exit.

The wheat must first be prepared for

direct breadmaking by a thorough washing, after which about a pint of tepid water to a pound of grain is added, and the whole is allowed to stand about six hours. At the end of this time the grains of wheat have swollen to double their ordinary size. It is then panified, mixed with the necessary quantity of yeast and salt, and poured into the machine. It falls between the threads of the moving screw and of the fixed contrary screw, which simultaneously crush the envelope and body of the grain, making of them a homogeneous mixture which, just before leaving the screws, forms a smooth paste. The work of kneading is terminated by the operation of a glider formed of two parallel surfaces. One of these surfaces is the extremity of the movable screw, while the other is fixed to the contrary screw and has a central hole through which the dough escapes in the form of a continuous roll.

The dough, on issuing from the machine, is put into baskets where it remains until it commences to rise. It is then divided into long loaves and placed on a table until the moment when it is to be placed in the ovens.

The process is really a step backward to the crude bread-making methods of the ancients, in which the entire grain was used. This, according to the supporters of whole-wheat bread, who insist that the present method of making flour robs it of most of its nutriment, is a step in the right direction, but other interests do not altogether agree with this.

"The world is not going backward," says the American Miller. "In a hundred years civilized man has struggled up from the brown and black bread of the peasant to the white bread of the rich. He is not going back to the bread of the eighteenth century in a hurry."

IMPRISONED FOR MUSIC

For a month before the competition for the Grand Prix de Rome, one of the most coveted prizes in the music world, the competitors are kept prisoners in the Chateau de Compiegne, so that they may prepare their compositions in complete freedom from worries and outside interruption. The music room of the chateau contains among many other musical instruments, the little harp that belonged to the King of Rome, son of Napoleon.

Prisoners of Music

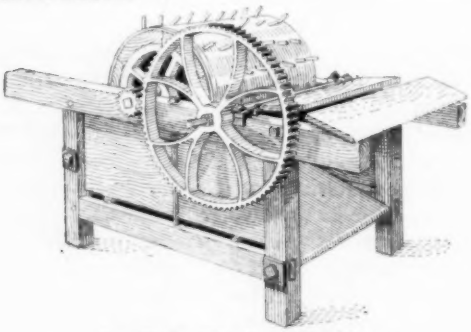
SMALL GRAIN YIELDS TO THE ACRE

That the average American farmer is profligate in the use of his land has been clearly understood for some time, but just how much so is clearly brought to mind by the accompanying figures. They bear witness that all of the European countries named, except Russia, produce more wheat and rye to the acre than does the United States, and that some of them produce more oats and barley. Where the average American acre of wheat produces 13.9 bu., the average yield in Germany is 28.4 bu., and in England 32.4 bu., both of which are more than twice as much. The table follows:

Country	Wheat	Oats	Barley	Rye
United States	13.9	29.8	25.5	15.8
Russia	9.3	19.4	13.7	11.5
Germany	28.4	47.3	34.4	24.6
Austria	18.3	28.6	23.9	18.1
Hungary	17.9	30.9	23.8	17.5
France	20.8	28.1	22.9	17.2
United Kingdom	32.6	44.7	34.9	26.7

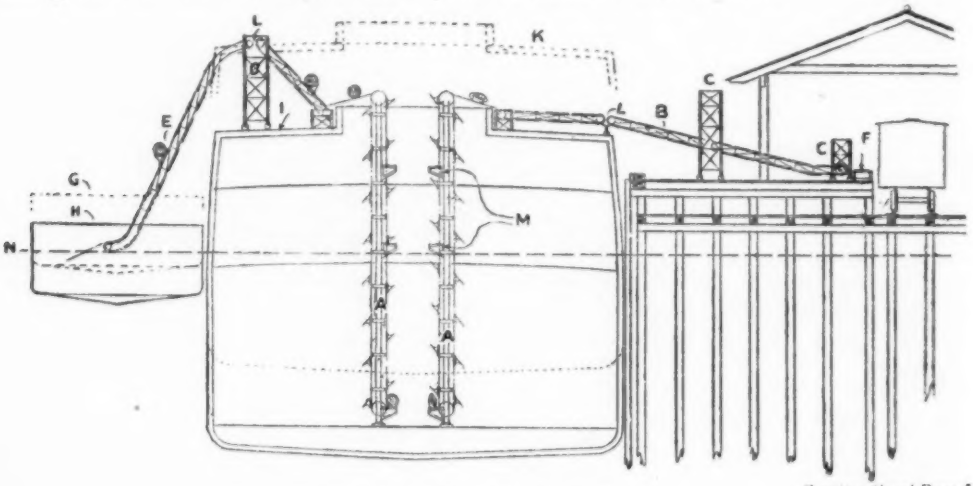
A GRAIN THRESHER ONCE CONSIDERED WONDERFUL

This grain thresher is believed to be the first threshing machine brought to the southwestern part of Indiana. It was bought by J. O. Black, an Indiana pioneer, long before the Civil war, and for several years was used to thresh all the grain in the vicinity. The first thresher to take the place of the old-fashioned flail, it was considered a wonderful piece of machinery when first introduced.



An Early Threshing Machine

The method of operation was simple. Horses at the end of a sweep turned the big power wheel, shown in the illustration, and this transmitted motion to the curiously-toothed threshing cylinder. The sheaves were fed into the thresher by hand, and after the wheat was threshed the straw was raked away and stacked, while the wheat, chaff, and all else was carried to an old-fashioned fan mill, turned by hand. The ancient machine was photographed in the condition it has been for the past 35 years, in the barnyard of a farm near Terre Haute.



Courtesy Canal Record

Sketch of Cement Unloading Plant

A, Vertical elevator; B, Portable apron conveyor; C, Adjusting tower; E, Barrel lowerer; F, Stationary apron conveyor; G, Barge empty; H, Barge loaded; I, Ship loaded; K, Ship empty; L, Universal joint and coupling; M, Loading stationary brackets; N, Surface of water.

UNLOADING OF CEMENT AT PANAMA

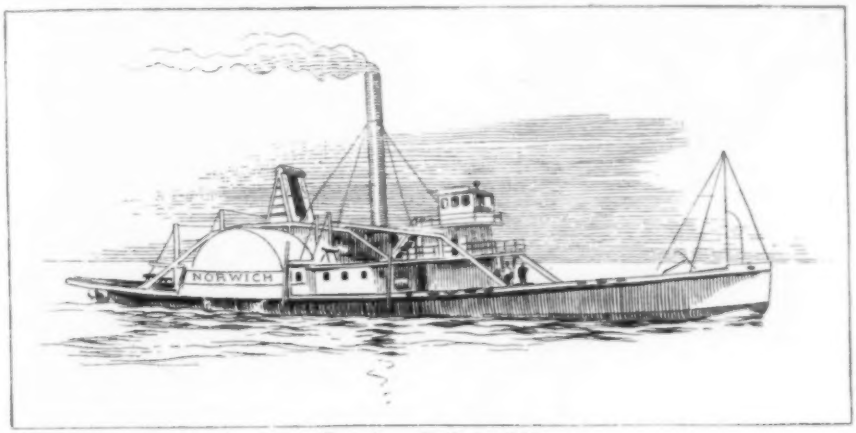
In order to facilitate the unloading of cement at the piers at Cristobal a contract was let several months ago by the Panama railroad for a system of six cement conveyor units, two for cement in bags and four for cement in barrels. Each unit will have a maximum capacity of 1,000 bags or barrels per hour, and the cost of the system will be $30,000.

That such an unloading system is necessary is shown by the fact that over 800,000 tons, or 4,000,000 bbl., of the amount of cement contracted for by the canal commission in 1908 is yet to be shipped to the Isthmus for use mainly in the construction of the locks. It will be carried by the twin ships "Ancon" and "Cristobal," each of which makes one round trip a month

between New York and Cristobal. The cargo capacity of the vessels is 10,000 tons each.

OLDEST STEAMBOAT IN WORLD

The recent Hudson-Fulton celebration on the Hudson drew attention to the fact that the oldest steamboat now



Steamboat Built in 1836

in commission in any part of the world navigates the Hudson river.

She is the famous old steamboat "Norwich," of the Cornell Line, and was built in 1836. Originally she plied as a passenger boat on the Long Island Sound route between New York and Norwich, Conn. Later she went to the Chesapeake where she ran for a time on the Baltimore and Norfolk route. Returning to New York she went on the Hudson, where she has been since, no season having passed without seeing her in active service. She has always been selected as the boat to open navigation in the spring and close it in the fall, her task for the past 60 years being that of a towboat.

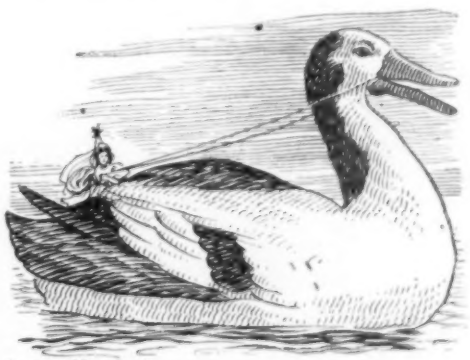
The original engine, placed in her by Cunningham & Hall in 1836, is still used, and is the last of its type. It is known as a cross head or square paddle engine, the single cylinder in upright position, actuating a piston which is topped by a cross bar, at the ends of which are placed the connecting rods.

The length of the old vessel is 175 ft., and her beam over guards is 45 ft.

A MOTORBOAT FLOAT

Motorboat carnivals, in which the little craft are disguised as floats of artistic or fantastic merit, have become a feature in the yachting events of the season on hundreds of lakes and rivers in the United States.

One of the prize winners in the carnival on Lake Hopatcong, which was one of the most interesting held during the past summer, is shown in the illustration. It is a duck 12 ft. high by 20 ft. long, driven by a fairy sprite resting on its back. The motorboat was completely covered, and no means of propulsion was visible.



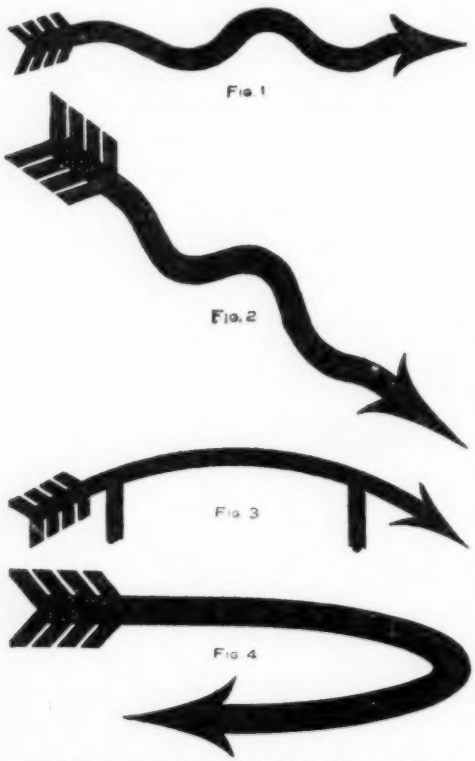
Courtesy Motorboat

Winner of Motorboat Carnival

The total output of farm wagons in a year of normal trade approximates 500,000.

ITALIAN DANGER SIGNS

Among the best warning signs in existence for automobiles are those of the Italian Touring club, the basis of



Winding Road—Steep Hill with Turns—Hidden Bridge—Sharp Turning

which is a simple arrow, bent or waved in such a manner that even the tourist who cannot read Italian can hardly help but define its warning. The three arrows shown in the drawings are excellent examples of how the idea could be adopted in this country. The first is placed horizontally on the signboard, but its waved appearance notifies the passing autoists that the road becomes winding with several turnings. The second, having a downward slant and one wave, designates a winding hill, while the third warns of a hidden bridge. Sharp, dangerous turns in a road are indicated by the arrow being bent back upon itself in somewhat the same manner as a child bends back a pin.

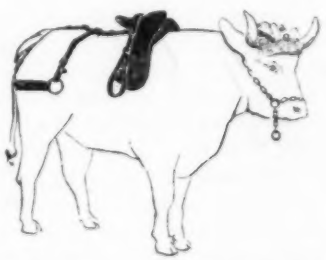
NEW FLUE JOINT FOR LOCOMOTIVE BOILERS

A veteran railroad man of Spokane, Wash., has secured a patent on a flue joint for locomotives which he claims will mean a saving in the operating expenses of the railroads as great as the dividends paid by them, which, including all the railroads of the world, was $278,000,000 in 1908.

His invention is called the never-leak flue joint, and consists of a steel point, 6 in. in length, which is welded into the boiler, making the joint inside, instead of on the outside, as at present. It is claimed that the present cost of keeping up locomotives, due to leaky flues, is from $1,000 to $2,000 a year per locomotive. A new locomotive, it is declared, will not run more than three months before its flues need repairing, and from that time on it requires an outlay of from $3 to $10 a trip to keep it in repair, with a new set of flues at the end of 12 or 18 months. It is upon these figures, that the big saving of a couple of hundred million or so is based, supposing, of course, that every engine in the world were so equipped and the flue joint perfect.

HUMANE HARNESS FOR OXEN

In many countries of Europe, where oxen are still used to a great extent in farm work, a crusade of considerable magnitude has been started against the ancient practice of harnessing the animals together by a heavy wooden yoke, and in France such a device as shown

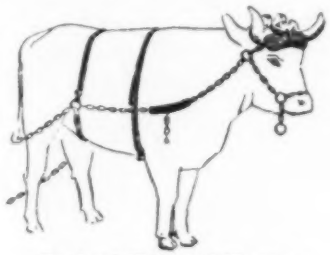


Loin Strap Used for Yoking Between Shafts

in these drawings is recommended in its stead.

It is a bar of curved wood or of flexible steel, provided with soft pads and made fast to the forehead just between the roots of the horns, thus transferring the pulling strain from the neck and shoulders to the head. Leather straps or iron chains lead from the head yokes to the implement or wagon being pulled. The arrangement allows of the yoking of one animal or a pair of them to shafts or poles of the nature used in attaching horses to vehicles, or the pairing of them together side by side or in file without shafts or poles, for tilling the soil.

It is claimed that with the old-fashioned wooden yoke the ground must be level and the oxen of exactly the same size and strength or one or the other of the animals will suffer torture in pulling. With the new method the pulling force is claimed to be always normal



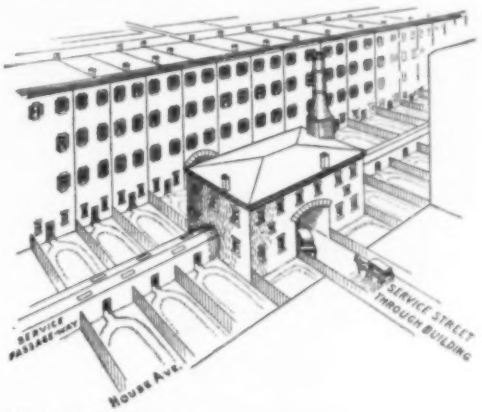
Forehead Yoke and Harness

for each animal, no matter what may be the condition of the ground or the difference in the power and size of the animals yoked together. Experiments show that oxen so hitched together can do double the work possible with the cumbersome yoke ordinarily used.

ONE-KITCHEN FLATS

Blocks of flat buildings with one common kitchen, a plan attempted in Berlin, have not met with success, according to reports. A syndicate, which had borrowed money to carry out the idea, erected one series of such dwellings, but soon met with difficulties, and a morning came when the tenants were unable to procure their breakfast. The drawing shows a contemplated row of such flats, which, however, will probably not materialize, now that the first venture proved a failure.

The shortage of the syndicate was



Courtesy Hotel News

Type of One-Kitchen Flats

presumably caused by lack of enthusiasm over the idea by the class of people expected to patronize it.

TEMPLE-TOPPED CHINESE ISLAND

The rocky, cone-shaped island shown in this illustration is called Orphan Island, in English, and lies in the Yangtze river in China. The house part way up its precipitous sides is

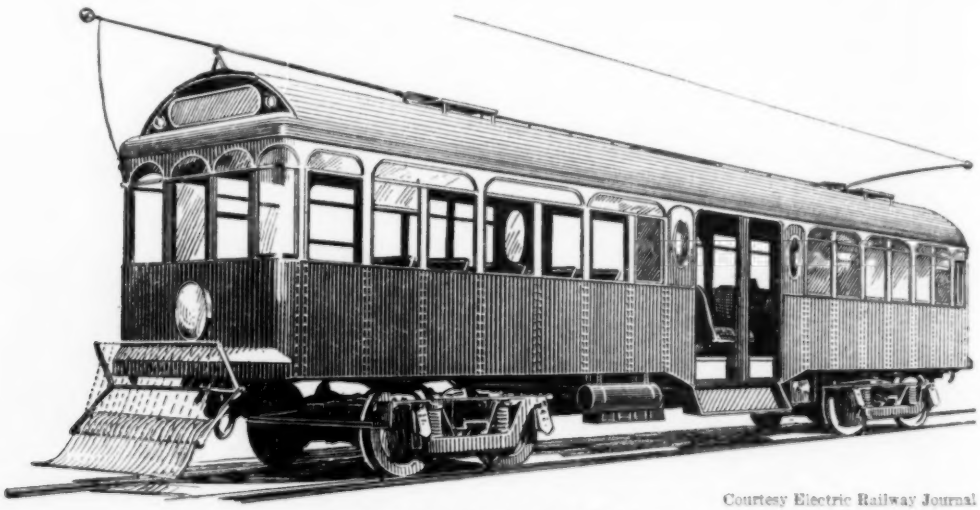
Courtesy Sketch

A Path of Virtue Somewhat Steep

occupied by many dwellers. On the crest is a little Chinese temple to which these people climb to worship.

STEEL CARS FOR SEATTLE INTERURBAN LINE

Ten all-steel cars of an original design have been added to the rolling stock of one of the interurban electric lines of Seattle, Washington. In the design of body the single side-entrance feature of the California type car has been used, but unlike the majority of such cars, the body has no monitor deck. The roof is formed of steel plates carried from the top of the windows on one side to the top of the windows on the other.



Courtesy Electric Railway Journal

Complete Car, Showing Side Entrance

The seating capacity of the cars is exceptional. Although the body is only 49 ft. long, the seats provide for 70 passengers, this being obtained by placing cross seats at each end of the car with the backs close against the bulkheads, and a long side seat on the blind side of the car facing the side entrance. The motorman's cab is on the right-hand side of the forward end of the car.

The aerial gasoline engine of the future, it is predicted, will be built on standard lines, lightened where metal can be saved without loss of strength, instead of the present featherweight motor.

ACROSS HUDSON STRAIT ALONE IN OPEN BOAT

A young Scotch harpooner, David Ritchie, recently made a venturesome and dangerous trip across the waters of Hudson Strait in an open boat to bring succor from the Moravian settlements of Northern Labrador to his companions on the barren shores of Baffinland. All had been members of the crew of the Scotch whaling ship "Snow Drop," which left Dundee in 1908. Loaded with a cargo of bearskins, walrus hides and one whale, she was wrecked in Frobisher Strait on her return trip, and the crew reached the coast of Baffinland in an open boat short of provisions. The men had been on an allowance of but one ship's biscuit a day, and were suffering bitterly when they at last reached an Esquimau settlement. They spent the winter of 1908-09 there, and with the coming of summer Ritchie decided to try to reach civilization.

With an Esquimau guide he traveled on foot and by dog sled 500 miles to a spot on Hudson Strait favorable for crossing. There he found a boat, and alone fought his way through drift ice and storm to the Moravian settlement where relief was secured.

PASSENGER RATES IN EUROPE

Most American tourists, according to a report made by U. S. Consul Ifft, of Nuremberg, return from a tour of Europe with an impression of cheap transportation on the government-owned railroads, but with many complaints as to the lack of what in the United States are regarded as the ordinary conveniences of travel.

The lack of such conveniences is real enough, but the cheapness is more seeming than real, and is largely due to the shortness of distances. From the accompanying table it would appear that in Germany railroad travel is cheapest, but this is not really the case. The fact that round-trip tickets at less than two full fares have been abolished, that extra fare for all express trains is charged, and that there is no free baggage, makes travel in Germany quite expensive.

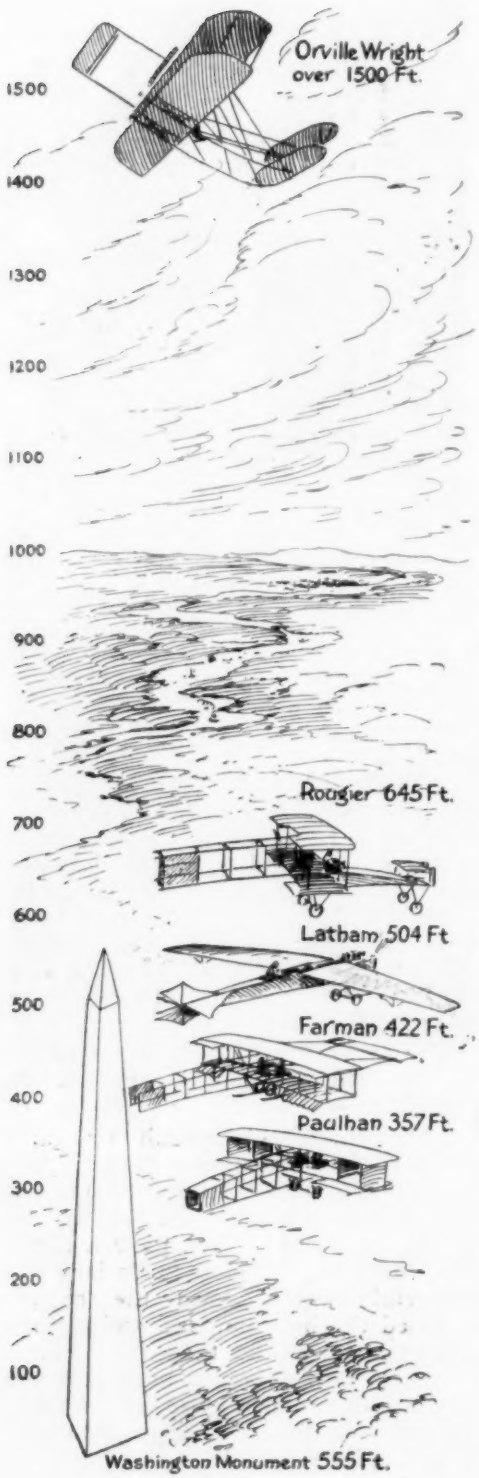
In Italy, the rates per mile are higher than on any of the other government-owned railroads, but a differential tariff offers some advantages that make travel quite cheap for long distance. For distances over 994 miles, the fare does not increase. In other words, a ticket from Chiasso, on the northern border, to Palermo in the extreme south, costs no more than a ticket from Chiasso to Naples, although the distance is 400 or 500 miles greater. The highest passenger rates prevail on the privately owned lines of England.

Country.	Class I. Cents.	Class II. Cents.	Class III. Cents.
Germany, government ownership.	2.73	1.75	1.16
Belgium, government ownership..	2.91	1.98	1.17
France, government ownership...	3.16	2.35	1.53
France, private ownership.....	3.48	2.34	1.53
Holland, government ownership..	3.29	2.47	1.65
Holland, private ownership	3.29	2.47	1.65
Italy, government ownership....	3.60	2.52	1.62
England, Great Eastern Railway, minimum	4.02	3.02	2.01
England, Great Eastern Railway, maximum	6.03	4.02	3.02
England, Southeastern and Chatham Railway	4.02	2.51	2.01

LARGEST FLAG IN WORLD

The huge American flag unfurled as part of Pittsburg's celebration last Fourth of July is the largest in the world. Its 180-ft. length by 30-ft. breadth was so large, in fact, that flying it became a menace to pedestrians. It wrapped itself around a lightning rod on the courthouse roof, gave a slight tug, and when it resumed its lazy but powerful floating with the breeze, dropped the lightning rod and a huge capstone down into the street. Then it began such a bombardment of the street with tile torn loose from around the capstone that its suppression was immediately demanded.

Flag Too Large to be Flown



THE HEIGHTS AEROPLANES HAVE FLOWN

The illustration shows the heights to which aeroplanes of American and French inventors have flown, as compared with the height of the Washington monument. Since the drawing was made, however, Lambert flew to a height of 1,300 ft. above Paris, but Orville Wright's altitude of more than 1,500 ft. still remains unbeaten.

CUT-GLASS GLOVE BOX

One of the newest acquisitions of cut glass for a woman's dressing table is a glove box with a lid that may be lifted on or off at will. The offering of these beautiful and expensive boxes so far placed on the market are only long enough for short gloves, but they are deep enough to hold many pairs.

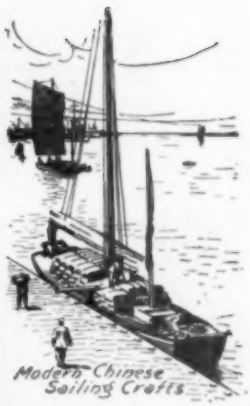
THE GROWING RAILROAD WEB OF CHINA

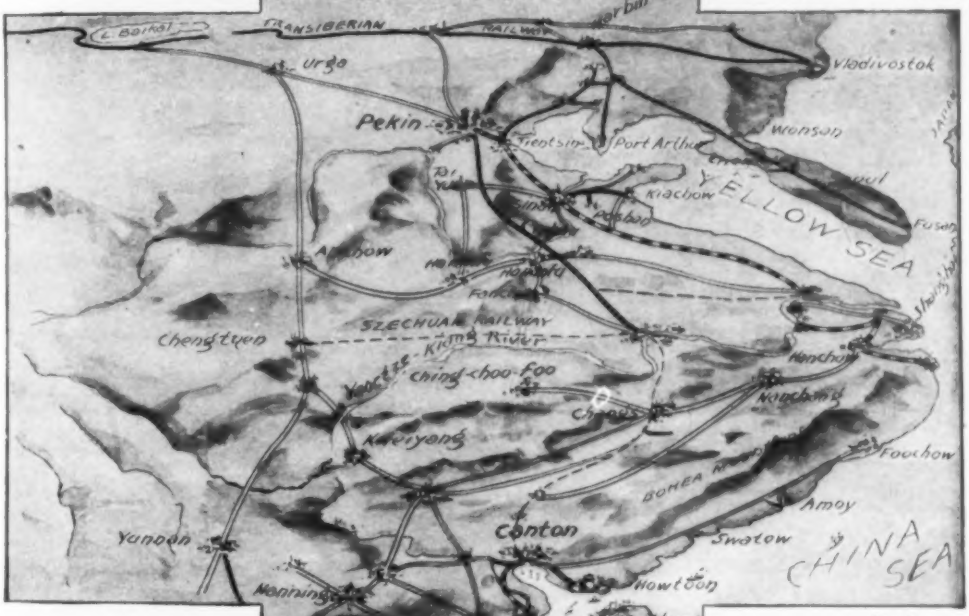
The white races of the world, with the exception of a few great men of the white nations, have so long considered China as asleep, with a "sleeping sickness" bound to last forever, that what really is occurring in a modern way is a cause for much general surprise.

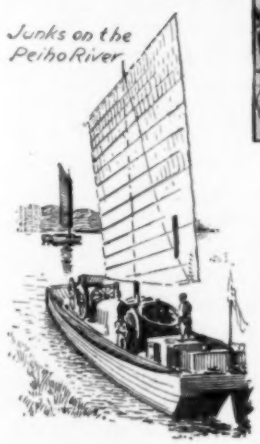
This ancient and most populous of all countries is today webbed with no fewer than 3,740 miles of railroads in full operation, and the web is growing rapidly. In addition, there are 5,260 miles of railroad projected, and of this, one-fourth is already actually under construction. Chinese opinion in regard to railways has altered to such an extent in the past decade that the desire of the country has not only ceased to oppose them, but to effectively control them as well.

China proper covers the vast area of 1,336,641 square miles, and counting its dependencies, including Mongolia, Tibet, Jungaria, and East Turkestan, the area is 3,856,100 square miles. The population reported in 1903 was 426,447,000.

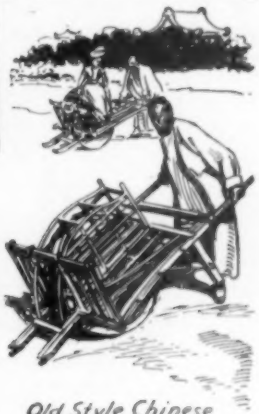
Modern Railway Station at Tientsin


Modern Chinese Sailing Crafts



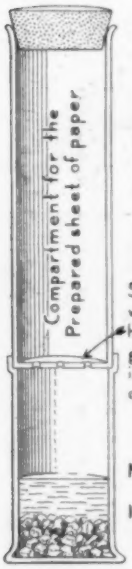

Junks on the Peiho River

Modern Paddle Steamers on Pekin Palace Lake


Old Style Chinese Road Carrier

ONE WAY IN WHICH THE FAKIR MAKES USE OF CHEMISTRY

The most popular and the unique fakir at Chicago's White City during the past summer was the "Hindu Fortune Teller," a large negro disguised by false hair and a long red velvet coat. The manager of the "Hindu" sells to advice seekers what appears to be a blank sheet of tablet paper, and after the purchaser's initials are written upon the paper, it is placed in a brass tube held by the fortune teller.


Compartment for the Prepared sheet of paper
Small openings which allow the hydrogen sulphide gas to pass slowly into the upper compartment
Muriatic acid and Iron Sulphide

The manager now says: "All we ask of you is that you put your mind upon the question which you wish answered, and by the means of telepathy and the power of Buddha you shall receive a written answer." The negro extends the brass tube toward heaven, utters a few groans,—probably meant to invoke the aid of Buddha—trembles from "exhaustion," and then delivers a neatly typewritten answer to the question, an answer general and vague enough to include a reply to any question likely to be asked upon such an occasion.

Deluding the Populace

The "Hindu" mystery is an application of a simple chemical experiment known to most high school pupils. The apparently plain sheet of paper has been prepared by means of a typewriter stencil and a mimeograph, using a colorless solution of lead acetate instead of ink. The brass tube held by the operator has at its lower end a compartment filled with pieces of iron sulphide in a weak solution of muriatic acid. This mixture at the lower end of the tube forms hydrogen sulphide gas which is allowed to escape slowly into the upper compartment of the tube. When the sheet of paper is placed in the compartment containing the gas the colorless writing becomes visible or, in the language of chemistry, the lead acetate which is colorless becomes lead sulphide which is black.

IMPORTANCE OF DR. COOK'S FOOD SUPPLY

That the attainment of the North Pole had always been attendant upon sufficient food and its means of transportation, and this only, is well borne out by Dr. Cook's lectures.

"No man has ever returned from the polar regions because he was stopped by any physical barrier," says Dr. Cook. "No one has ever returned because the cold was too severe or the work too hard. It has always been the lack of a food supply that has stopped advance. If you keep a man's stomach full you can send him over any part of the Arctic or Antarctic; the whole unknown area is open to him as long as he has sufficient food and means of transporting it.

"We simply took pemican as our food supply, but instead of making it only part of our ration, as has been done by other men, it was practically our all, and the means of our success. The original pemican was made by the buffalo-hunting Indians, by drying buffalo meat, pounding it, putting it in skin bags, and pouring over it melted fat,

sugar and currants. We borrowed this idea, but made pemican of beef and beef tallow. There is no food for the Arctic that will take its place; there is nothing else that will give the same amount of energy for the given weight. In the preparation nothing is removed but

The smudge pots used were of many different types, some burning oil, and others coal. The temperature in the orchards was actually raised eight and nine degrees over the entire 27 miles of territory, as many as 300,000 smudge pots being used.

Substitute for the Sun's Heat

water, and one pound of it is equal to five pounds of other meat. Also, it does not freeze, although it will get very hard, while fresh meat freezes so hard at 40 degrees below zero that it becomes difficult to break it with an axe."

ARTIFICIALLY HEATING 27 MILES OF ORCHARDS

One of the greatest feats of artificial outdoor heating ever attempted was resorted to by fruit growers near Grand Junction, Col., to save last year's crop of fruit, estimated at $3,000,000 in value. Thousands upon thousands of smudge pots were scattered through the orchards over 27 miles of territory during a belated frost last spring, and the raising of temperature that resulted effectually dispelled the frost.

TIMBERS OF ENGLISH WARSHIP IN AMERICAN HOME

Timbers of the famous battleship "Wellington" are being used as supports and rafters in the $200,000 residence of I. N. Phelps Stokes at Greenwich, Conn. Mr. Stokes, when he bought the timbers in England, was not indulging himself in things historic, although such material in the house will add greatly to its interest. His idea was to get good, strong wood, and the timbers from the "Wellington" are of teak, which is prized because of its great durability. Most of the timber will be used as rafters in the great dining room.

In England there are several firms that make a specialty of breaking up old vessels to get teak and other valuable woods.

GENUINE ANTIQUE CHAIR

This illustration shows a genuine antique chair, although not of the kind

Antique Schoolhouse Chair

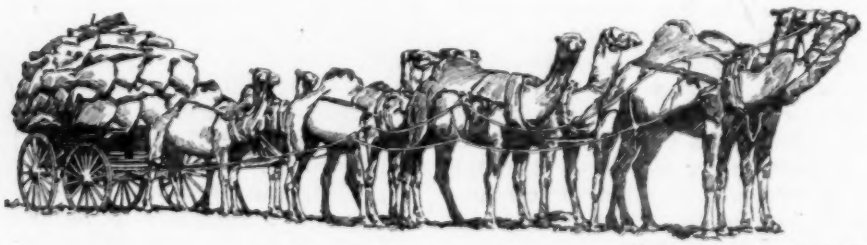
or design to be especially attractive to the people who wish to furnish their homes with antiques. It is a queer plank chair, 127 years old, and for many years was used in a school in Lynnfield, Mass. It is made of 3-in. timber, and the seat is 20 in. from the floor and 11 ft. wide.

HISTORIC SWORD RECOVERED

After a search of more than 30 years, the sword presented to Blackhawk, the famous war chief of the Sacred Foxes, by Andrew Jackson, has been recovered and is to be presented to the Iowa historical society. The sword, which was worn continually by the Indian warrior, was buried with his body on the farm of Capt. James Jordan, near Iowaville, Iowa. It was later recovered by the Jordan family and presented to an Iowa Masonic temple. The temple burned, but the sword, although taken from the building, disappeared. Search has been made for it ever since, and its final recovery was due to the aid of a granddaughter of Capt. Jordan.

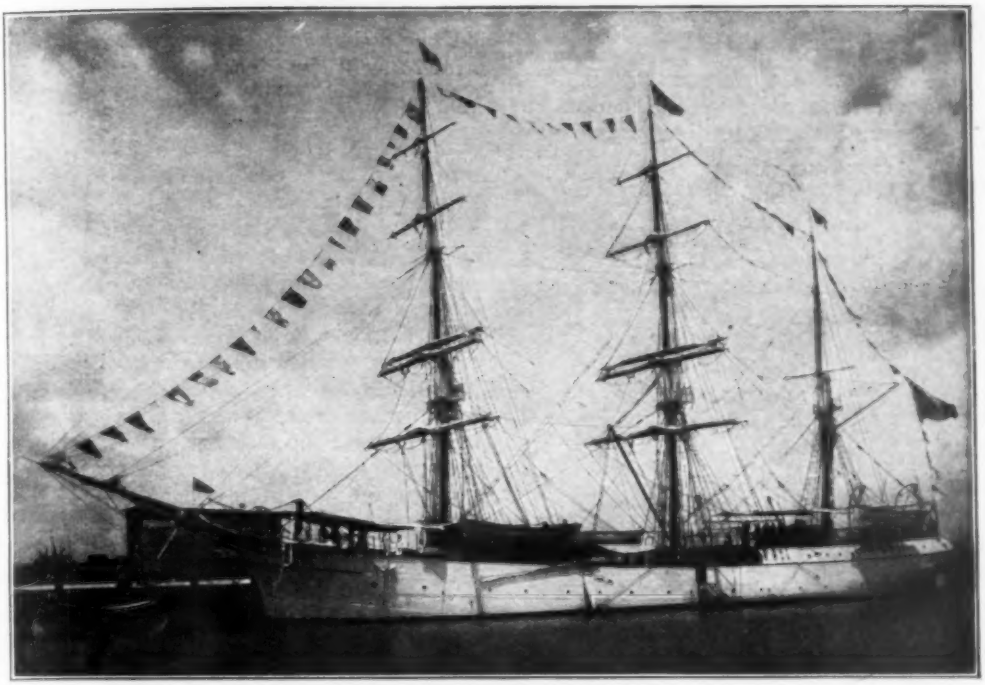
EIGHT-CAMEL-TEAM MAIL COACH

The mail coaches of the west are a memory of the past, but it is quite certain that even in their prime they could not approach in uniqueness the mail coach shown in this illustration. It is composed of a wagon drawn by a team of eight camels, all of which have been broken to service within the last six months, and it travels from Port Augusta, South Australia, to the Tarcoola gold fields, a distance of 300 miles into the interior. Each camel is provided with winkers and a noseband, halters being attached to the latter, by which they are steered. The team easily draws two tons of mail over a sandy track.



Courtesy Australasian Traveler

Camel Mail Coach of Australia



Mexican Naval Training Ship at Dock in Galveston

GOOD ROADS ACTIVITY IN WASHINGTON

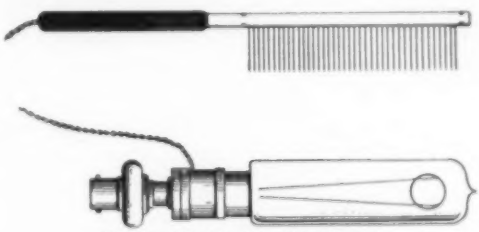
One million dollars is to be expended on state and state-aid roads in the eastern part of the state of Washington this spring as a means of impressing the people with the practicability of constructing such highways. The roads will be built in Douglas, Lincoln, Adams, Spokane, Whitman, Asotin, and Garfield counties.

Some time ago the state legislature appropriated $124,000 to provide for five state rock crushers. These will be located at central points in several of the counties.

ELECTRICALLY HEATED COMB

A very simple, but effective, device for drying the hair is the electrically heated comb shown in this illustration. It is the invention of a Frenchman, and the elongated electric bulb accompanying it has a novel mission. The interior of the back of the comb contains a ferro-nickel spiral which is heated by the passage of the electric current, and this heat extends to the end of the teeth.

The lamp shown in the drawing with the comb is not for lighting purposes, but as a resistance to the current. The filament scarcely reddens, but serves to limit the intensity of the current to such an extent that the heat of the comb is always at a gentle temperature.

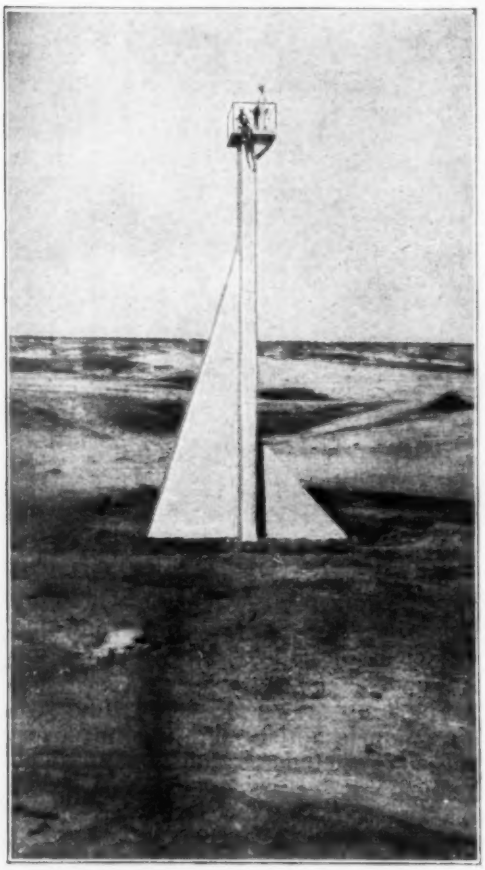


Comb with Electric Attachment

A great cement plant is being erected at Orofino, Idaho, involving an initial expenditure of $1,500,000 and will turn out 2,500 bbl. a day.

CURIOUS RESERVOIR OUTLET TOWER

This curious tower, rising from a bare stretch of ground in the illustration, is the outlet gate to a large reservoir in northern Colorado. It is constructed of reinforced concrete, the reinforcing being a framework of more than three tons of steel. The tower is nearly 50 ft. in height.



Reservoir Tower in Colorado

SPECIAL AUTOMOBILE ROADS

The general public seems to entertain the idea that special automobile roads, on which the speed enthusiast could defy death to his heart's content, should be considered by the autoist as a boon almost too good to be true. Yet, if a movement for such roads should become general in this country, the far-seeing automobile owners would be first to fight the idea.

This is now being clearly demonstrated in England, where a movement is on foot for just such roads, to be built by the proceeds derived from speed fines. Such roads, if built, would be constructed as cheaply as possible, as far as the cost of right of way is concerned. They would be straight courses through the back doors of the villages, void of nearly all the touches of nature that make a country road beautiful, and sure to react upon the sane automobile owner whose real joy in the possession of an automobile is the opportunity such a means gives him for enjoying the country.

An army of auto owners is now fighting the idea of special roads because of these reasons, believing that, should they be built, the village and county authorities of England would expect their universal use and legislate in such a way that the beautiful winding country roads would be closed to automobile traffic at a speed of more than seven or eight miles an hour.

AERIAL ATTIRE FOR WOMEN

The few women who, so far, have flown as passengers in aeroplanes have been compelled to allow their clothing to be bound tightly about them, for fear that a flowing skirt might become tangled in a vital part of the steering or propulsion mechanism, thus causing a fatal accident.

Such a danger is made impossible by the attire shown in this illustration. It was designed in France and several such costumes have already found a market and are being used.

Costumed for an Aeroplane Ride

The French commissioners of meteorology have declared their disbelief in the efficacy of cannon discharges to dispel threatened hailstorms.

HOW TO MAKE A CHINA CLOSET

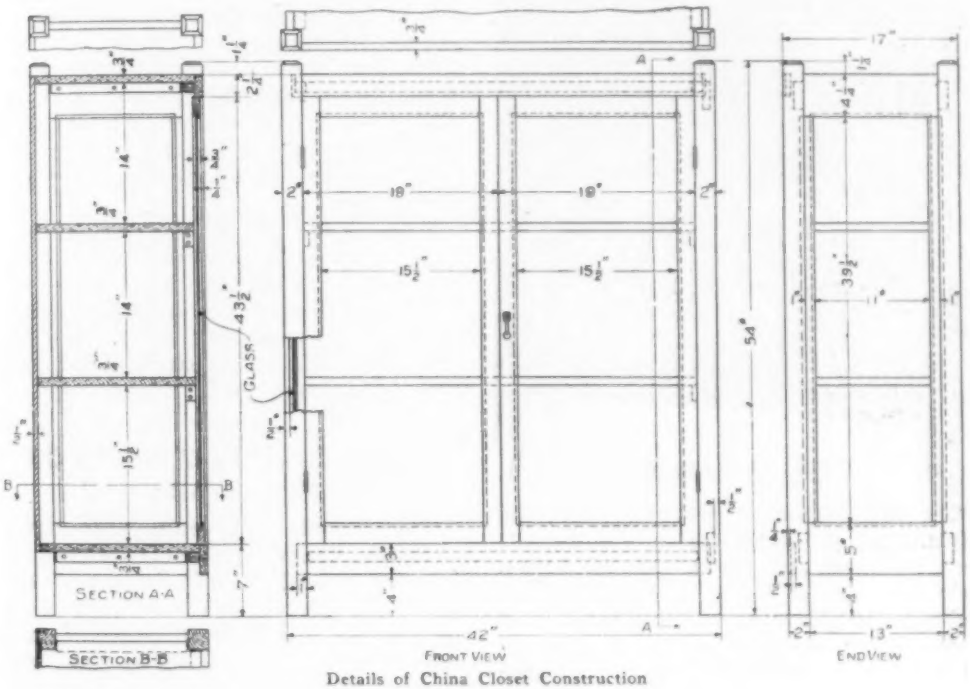
This beautiful piece of mission furniture can be made by anyone who has a few good tools and knows how to use them. The cost is very moderate and if you are convenient to a mill a great amount of labor can be saved by ordering the pieces ready cut to length, squared, and sanded. Quarter-sawed oak should be used and the material needed will be as follows:

4 posts 2x2x54 in., S-4-S.
2 top and bottom boards, ¾x15¼x39½ in., S-1-S.
2 shelves, ¾x15½x38 in., S-2-S.
2 lower end braces, ¾ by 5 by 15 in., S-2-S.
2 upper end braces, ¾ by 4¼ by 15 in., S-2-S.
1 lower front board, ¾ by 3 by 40 in., S-1-S.
1 upper front board, ¾ by 2¼ by 40 in., S-1-S.
4 door frames, ¾ by 1¾ by 43½ in., S-2-S.
4 door frames, ¾ by 2 by 19 in., S-2-S.
4 upright end pieces, ¾ by 1½ by 39½ in., S-2-S.
5 back pieces, ½ by 8 by 46½ in., S-1-S.
2 cleats, 1 by 1 by 37¾ in. soft wood.
4 cleats, 1 by 1 by 12¾ in., soft wood.
4 blocks ½ by 1 by 1½ in.

First be sure the posts are perfectly square and of equal length. Either chamfer or round the upper ends as desired. The mortises can be laid out and cut or they can be left until the tenons are all made and then marked and cut directly from each tenon.

The top and bottom boards should have the corners cut to clear the posts as shown in the drawing. The top board should be finished on both sides and the bottom one on the upper side only and be sure to get the best side up.

Cut the tenons on the front boards



Details of China Closet Construction

back ¼ in. from the face as shown in the end view. The boards should be finished on the outside sides and edges. The end pieces are fitted and finished in a similar manner except that the inside edge is rabbeted for the glass as shown. The side pieces are also rabbeted for the glass and the posts have grooves ½ in. deep cut in them to hold these side pieces. They are glued in place and this can be done after the frame is put together.

The two shelves are finished on both sides and the front edges. The doors are fitted in the usual manner by a tenon and mortise joint at the ends. They are rabbeted on the inside for the glass and are finished on all sides.

Before gluing any of the parts together, see that they all fit and go together perfectly square. The posts, side, and front pieces should be glued and assembled, then the top and bot-

China Closet Complete

tom boards put in place to hold the frame square when the clamps are put on. Leave dry for about 24 hours, then scrape all the surplus glue from about the joints as the finish will not take when there is any glue. Fasten the top and bottom boards to the frame by means of screws through cleats as shown in the drawing. The backing is put on and finished on the front side. A mirror can be put in the back without much trouble, if it is desired. The shelves should be put in place and held at the back by screws through the backing and at the front by two small blocks on the posts as shown.

After the closet is all assembled it should be thoroughly gone over with fine sandpaper before any finish is applied. It can be finished in any one of the many mission stains which are supplied by the trade for this purpose.

Nearly 1,000 less deaths were recorded on American railroads the last fiscal year than in the previous one.

SCHOONER SALVED IN UNIQUE WAY

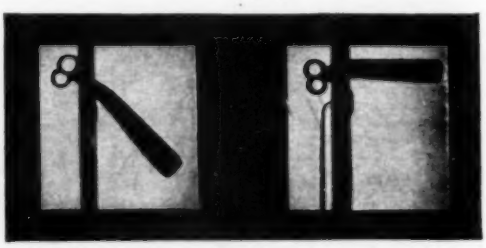
The schooner "Bender Brothers," which was stranded more than three years ago on the mud flats of the Kuskokwin river, Alaska, 20 miles inland from Bering Sea, recently reached Port Townsend, Wash., after a salvage feat unique in marine annals.

The vessel was salved by its master, a few missionaries, and a number of natives, by digging a canal nearly three miles long through the flats. This required many months of labor, and, by taking advantage of the extreme high tides, the ship was floated a short distance at a time until she again reached deep water.

The voyage down the coast to Port Townsend was also remarkable. Captain John Krioflich brought her down to Puget Sound without navigating instruments or proper stores, and his crew consisted of one seaman and four stranded prospectors.

NIGHT ILLUMINATION FOR SIGNAL ARMS

Illuminated backgrounds for signal arms are being tried with success on the Centre and Clearfield electric railway in Pennsylvania. A lamp fixed behind the post and provided with a suitable reflection diffuses the rays over the reflecting board, causing the arm, or arms, to stand out black. The photographs shown were taken at a distance of 150 and 100 ft. It is



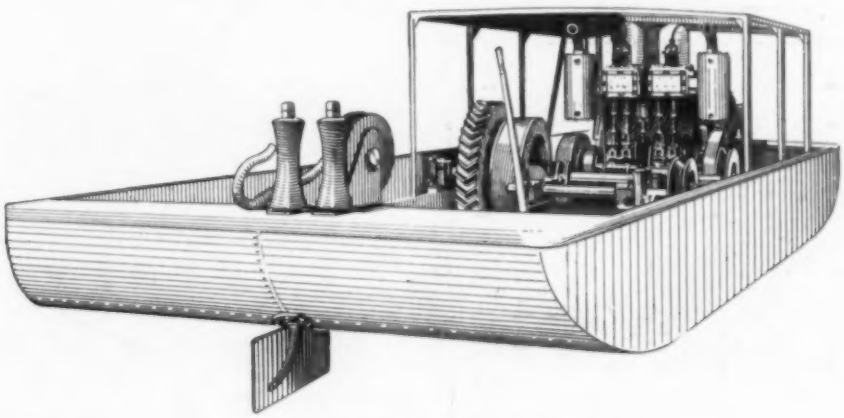
Reflectors for Railroad Signals

claimed that the position of the signal arms can be seen from as far distant at night as is common in the daytime.

MOTOR-OPERATED CHAIN-HAULING BOATS

Gasoline-operated chain-haulage boats of the type here shown are now being used along the irrigation canals of several sugar plantations in South America for the transport of sugar cane.

The boats are flat-bottomed craft, with the gasoline engine amidships,



Boat Tows Barges by Pulling Self Along Chain

driving winding gear which reduces the 400 revolutions per minute of the engine to 50 revolutions per minute at the chain sprocket. The chain is laid along the bed of the canals, and is picked up over the bows of the haulage boats and dropped over the stern. These boats tow the cane-laden barges, a number of which can be dragged behind. The motive power, to explain more fully, is gained by the haulage boat dragging itself along the chain in somewhat the same manner that a man climbs a rope hand over hand, the sprocket taking the place of hands.

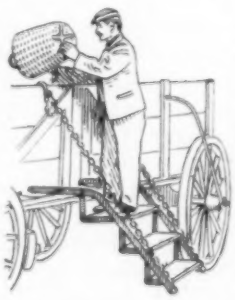
The boats are steel-hulled and double ended, with a rudder at either end. The direction of running is accomplished by simply shifting the chain from the upper to the lower side of the sprocket. The rate of haulage is about 3 miles an hour, and tests show that the cost by this method is only one-sixth of that required by the old method of hauling the barges by bullock traction.

ARMY AEROPLANE TO TRY MUFFLERS

The flying officers of the U. S. signal corps are experimenting in muffling the motors of the army aeroplane, so that the flight of the machine may be made comparatively noiseless. Whether or not mufflers are advisable has yet to be determined, the addition of such devices not only adding weight, which is not such a serious drawback, but serving to weaken the power of the engine to a certain extent as well.

FOLDING LADDER FOR WAGONS

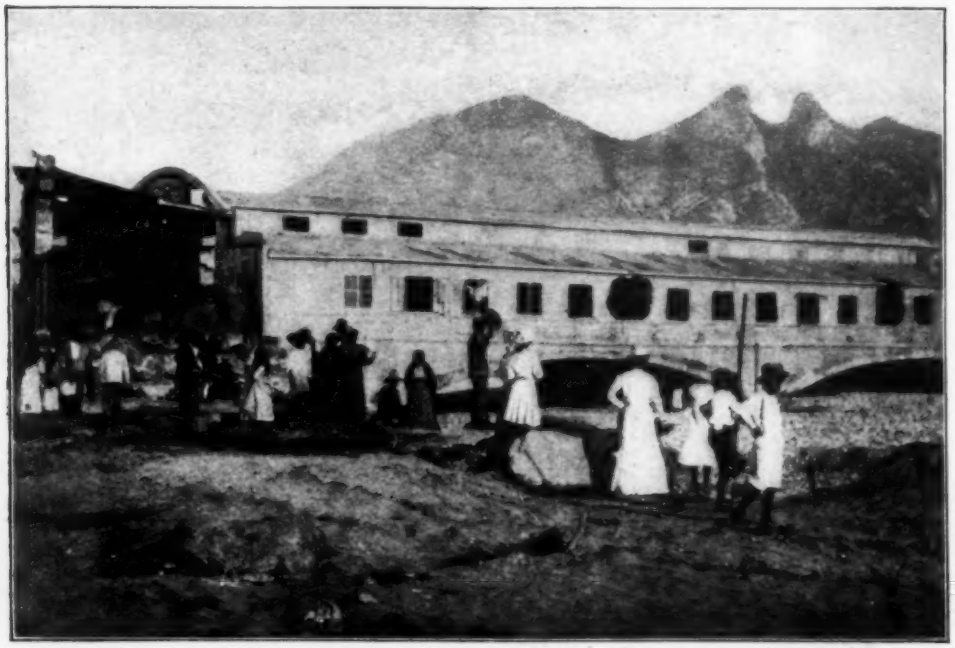
The jointed, collapsible wagon ladder shown in the illustration has been patented in Germany, and is especially designed for milling wagons. It will undoubtedly prove an excellent attachment, however, for any kind of high-sided wagon used for the transportation of farm produce or other materials in the bulk. The illustration shows the method of attaching it to the side of a wagon, against which it folds up when not in use.



CEMENT BUILDING RESISTS FLOOD

While 90 Blocks of Other Structures Fall

The only structure in the path of the great flood that swept down the Santa Catarina canyon and overwhelmed Monterey, Mexico, with sorrow and disaster on the night of August 28, 1909, which came out of the ordeal practically unscratched was the combination bridge and market house which spanned the stream along which the deluge took its course. This bridge is built of reinforced concrete, and it successfully endured the supreme test of strength and durability during the flood. The torrent of water swept away 90 blocks of buildings, many of them large stone structures, and caused a loss of more than 3,000 lives, but it scarcely made its impress upon the reinforced concrete structure which stood squarely in front of its battering force. The current of the flood was 40 miles an hour. It was 1,400 ft. wide and 35 ft. deep. The only damage which the combination bridge and market house sustained was made by two telegraph poles which struck the side of the market house full force, making holes through which the poles entered. They were found inside the building when the flood subsided.



Combination Concrete Bridge and Market House

KIEL CANAL TO BE ENLARGED

The Kiel canal, the great connecting link between the North Sea and the Baltic, on which Germany depends for the passage of her battleships and merchant marine, has proved so inadequate to accommodate the advance in shipbuilding that $55,000,000 is now to be expended in widening and deepening it.

The canal, which was opened in June, 1895, was then considered to be large enough for all time. The locks had a length of 487 ft., a width of 81 ft., and a depth of 32 ft., and the cost of the project was about $38,000,000. Now, to really make the canal a factor

in increasing the power of the German navy, the object for which it was built but which it never accomplished, the depth must be increased to 36 or more feet, the width of the locks to at least 100 ft., and the passing places must be increased from 8 to 11. In the new plans, four of these passing places will be spacious enough to accommodate an entire squadron.

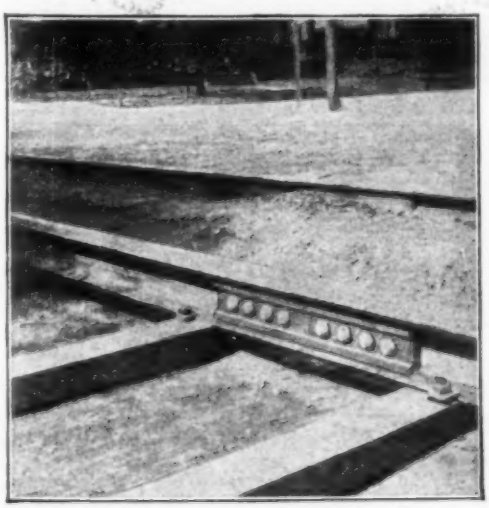
An army of workmen is already engaged on both sides of the canal in the necessary work of preparation.

THE COST OF REBUILDING SAN FRANCISCO

The value of the new buildings erected and the alterations made in San Francisco from May, 1906 to July 31, 1909, is, according to the architectural club of that city, $139,584,538. The amount of steel used was 284,715 tons, with a total value of $20,784,195, or an average of $73 per ton.

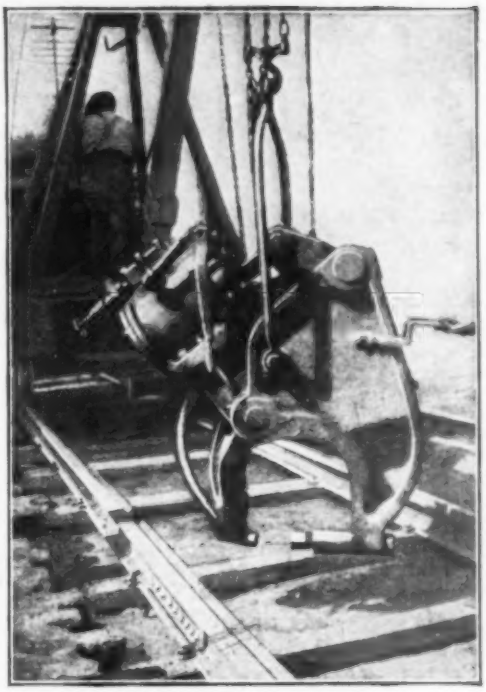
RIVETING TRACKS WITH POWERFUL MACHINE

The new tracks being laid by the Cleveland electric railway company are



Rail Joints Riveted Instead of Bolted

riveted instead of bolted at the rail joints. The powerful, electric-driven machine by which this is done is shown



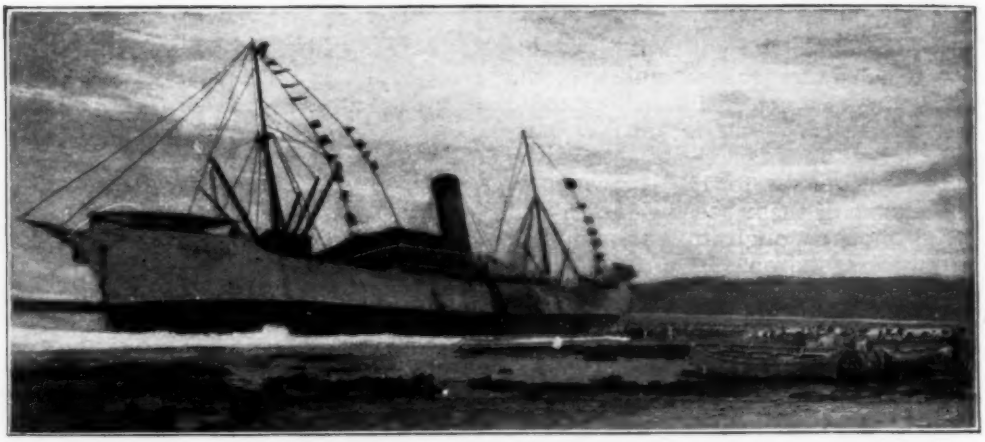
Machine That Rivets Tracks

in one of the illustrations, while the other shows a completed joint, and the steel I-beams that are replacing wooden ties.

PRISON STREET-CARS IN BERLIN

Prisoners are transported from the jails of Berlin to the short-term prison in the suburb of Tegel on specially constructed street-cars, each of which contains 30 cells. A motor car draws from one to three of these cars the distance of about seven miles every day, this means of prison transportation having been made necessary by the municipality of Tegel.

When Berlin expressed the desire to have a short-term prison located there, the authorities agreed on condition that the prisoners should be brought to it without attracting attention, and that discharged inmates should not be released in Tegel. The cars run directly into the prison on special sidings, and the public never sees the unwilling passengers.



Wrecked on a South Sea Island

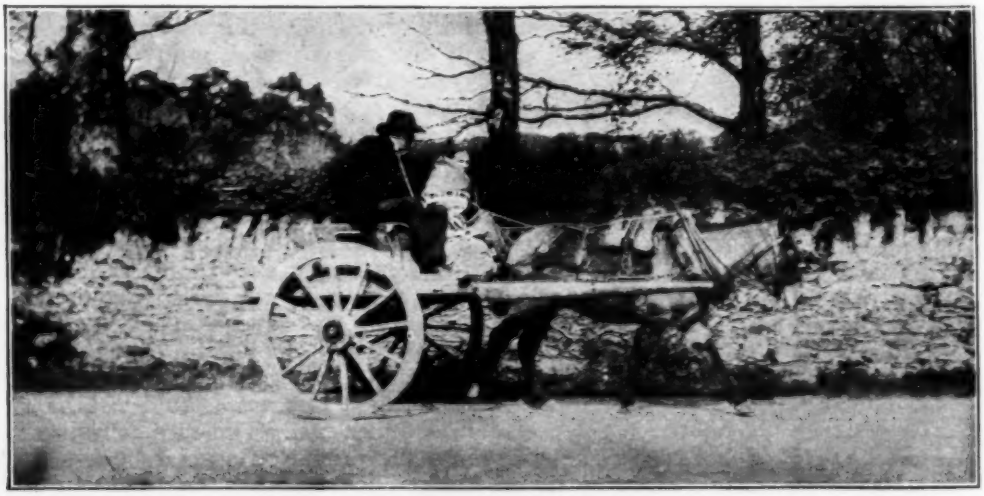
WRECK OF THE "OCEAN QUEEN"

The steamship "Ocean Queen," of Bergen, Norway, bound for the Island of Makatea, one of the Paumetu group of the French possessions of the South Pacific ocean, was wrecked on that island in September, the cause being a breakdown in the engine room.

A strong wind drifted her against the reef, and after a pounding of about 10 hours she went down. The illustration makes her appear as washed almost high and dry on the shore, but she is up against a treacherous reef with deep water beyond.—Contributed by Alex Drallet, Popeete, Tahiti.

ON THE ROAD TO KILLARNEY

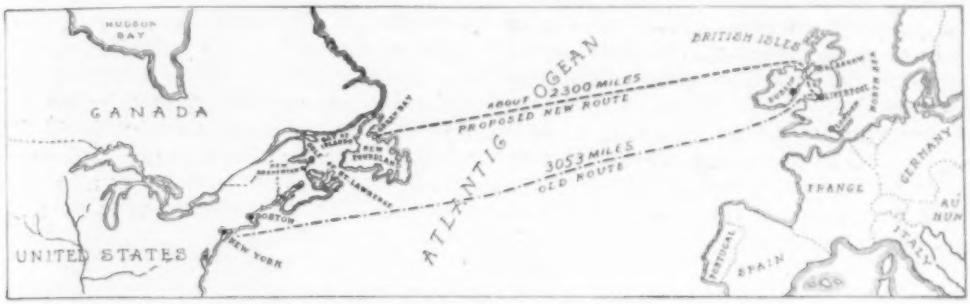
With the exception of a few touring automobiles, perhaps, an Irishman returning to his country after years of absence would find again the vehicles of his childhood, unchanged in design or manner of building. This illustration shows an Irish family on the road to Killarney.—Photo by Miss Beatrice Oliver.



An Irish Farmer's Cart

A SHORT TRANS-ATLANTIC ROUTE

Much progress is being made, according to U. S. Consul Benedict, of Newfoundland, in the project of a trans-Atlantic steamship route from



Saving Time in Crossing Atlantic Ocean

that country to Europe. The object is to provide the shortest possible route between Europe, the British Isles, and America.

It is proposed to run a line of fast steamships from some port in England to a port on Green Bay. From there an 85-mile railway will be built to some port in the Bay of Islands, on the west coast, from which a fast line of steamers will cross to some point in Canada. This will make the journey from Great Britain to Canada and the United States 24 or 36 hours shorter than by any other route, and save nearly half the sea voyage.

An important consideration in the project is the fact that there is a zone stretching eastward from Green Bay, in a direct line to Great Britain, almost entirely fog and wind free. The approach to Green Bay is north of the Grand Banks and south of the dense fog which envelops the Straits of Belle Isle.

The Newfoundland government is giving material support to the project, and it is expected that eventually the Straits of Belle Isle will be tunneled and a railway built through Labrador to connect with the Canadian system of railroads.

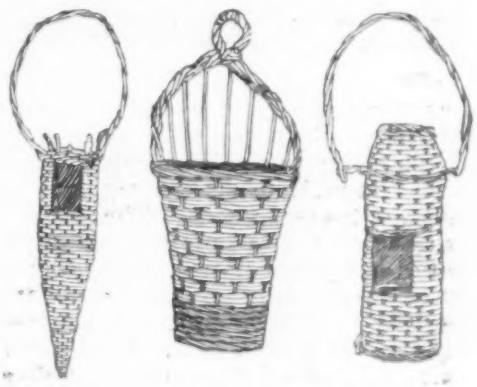
Out-of-season flowers can be forced by treatment with ether.

FARMAN BREAKS OWN DISTANCE RECORD

When Henry Farman flew a distance of 111.78 miles in 3 hours, 5 minutes, at the Rheims meet, thereby winning the Grand Prix de la Champagne, his feat was considered sufficient to remain unbeaten through the year, but on Nov. 3 he covered a little over 144 miles, remaining in the air 4 hours, 6 minutes, and 25 seconds. This long flight won for him the Michelin cup.

THREE ARTISTIC HANGING BASKETS

Three excellent examples of basket craft in this special line are shown in the accompanying drawings. The two smaller baskets, one of which resembles a lantern in shape, are for cut flowers and have cups inside to hold water. The large basket is designed to accommodate a potted plant.



Hanging Baskets for Flowers and Plants

TRANSPORTING ARMY SUPPLIES IN THE PHILIPPINES

Transportation methods for our Army in the furthermost frontier of the U. S., far-off Mindanao, are not unlike they were in the days of frontier military posts here at home. The accompanying picture shows a wagon train crossing Mindanao with a load of supplies for interior garrisons. The country here is very wild and the Moros very treacherous. Hardly is a trip of this kind made but what one or more of the escort, which rides at the head and rear of the train, is killed.

Wagon Train with Supplies for Interior Garrisons

Sometimes the civilian teamsters are shot from their seats by murderous Moros hiding in the bush by the roadside. Six-mule teams are required to haul the army wagons. The picture also shows a Signal Corps telegraph line of hasty installation. These lines are ofttimes strung up in a single day, covering great distances, and are fastened to trees or any other obstacle which will afford a support.

Wyoming promises to become the principal source of asbestos production in the United States.

RICH PRIZE FOR FLIGHT AT FIXED ALTITUDE

As one by one the difficulties of aerial flight with heavier-than-air machines are overcome, and the prizes for such success are won, still more ambitious tests are devised and still larger prizes are offered. The last, according to reports from abroad, is a $50,000-prize for the first aviator who can rise, with a fixed point as center, to a height of 800 ft., fly for a distance of 3,250 ft. without varying the altitude, and then return and fly for 15 minutes at a height of 65 ft. over the point of departure.

The prize is offered by a group of French, German, and Belgian patrons of aviation, but as yet inventors have failed to devise the mechanism which will enable an aeroplane to keep an exact altitude, but two English engineers claim they have solved the problem in the following manner: For a 28-ft. aeroplane, two or more disks, 4 ft. in diameter, are placed, paddle-wheel fashion, on either side of the main frame, and are driven at 1,500 revolutions per minute. This, it is declared, produces a similar effect to that achieved by the wings of a bird in beating the air.

EDITORIAL

The appalling accident at the Cherry mine, from which nearly 300 dead bodies are being lifted as these lines are written, will revive for a time the attention to safety devices which periodically engage the attention of press and public as these events occur. Notable improvements have been made in recent years, to a greater extent in England than in this country, which have reduced the death loss; expert and frequent inspection, the use of steel and concrete in shaft and fan house construction of the newer mines, more scientific ventilation, safer and better explosives, and a more careful enforcement of the rules against carelessness generally. In spite of all this, the man who goes down into a mine in the morning has no assurance he will return alive at night.

Every steamer carrying passengers is required by law to provide such a number of life preservers as will insure one preserver to each passenger. These life preservers do not always save all the passengers; indeed, wrecks have occurred where exploding boilers wrecked the ship in an instant, allowing no time to make use of a life preserver; or the vessel struck a derelict in the darkness of night far out on the high seas, and the victims, strapped about with cork jackets, perished after floating in the icy waters for hours. However, the life preserver on board has saved many lives and the Government continues to require them as a fairly reliable safeguard.

Within the past three years invention has provided an apparatus not difficult to put on, consisting of a helmet quite similar to that used by divers, a tight fitting rubber jacket, and a small tank of oxygen. With his head within this helmet, the oxygen flowing to furnish sustenance for his lungs, and an electric flashlight in his hands, the city fireman is able to work for considerable periods in basements filled with dense smoke, engineers of ice plants fearlessly enter rooms full of deadly ammonia gas, and the rescue parties who go down into mines do so without danger from the mine gases.

Apparently it has not occurred to any of our law makers to require each miner while in the mine to be provided with one of these life-saving helmets and an electric flashlight. With such equipment it would seem that in many accidents the men would have time to put on the oxygen helmet, and walk or run to some shaft where cages or ladders would lead to the surface. Even if all avenues of escape should fail, they would still be able to retreat in safety to some remote part of the mine, and there, as history so often records, erect barriers to keep out the gases and preserve life for a number of days. If to this equipment were added a canteen of water—for not all mines are wet—and a package of the much ridiculed army food tabloids, it would seem that the chances for ultimate rescue might be greatly increased.

Those of our readers who have never been down several hundred feet into a mine, nor know how ignorant thousands of the miners are, cannot appreciate the difficulties of helping such men save themselves. But they are human beings, and their very ignorance makes the obligation of society so much the greater to compel them to learn how to use safety appliances. The oxygen helmet or something similar will be scorned or looked on with suspicion by many miners, but if they can learn how to make an undercut and get the fall they can be taught the use of the safety suit.

Improvements can doubtless be made to render mines safer, but the idea of making each miner a rescue party of one to save himself would seem to be the next logical step.

* * *

The successful railroad official who sat at my side while travelling recently, fell into a reminiscent mood, and was entertaining a number of interested listeners with stories of early railroading, before the days of air brakes and other safety appliances. Now, as every man knows who has had the advantage of experience in the general office of a large railway, it offers the finest training a young man can have. So I said to him, "To what one thing do you most attribute this fact?"

Without a moment's hesitation he answered, "*The discipline which teaches the value of time.*" Then he continued: "A green boy enters the operating department, and he finds a condition of absolute exactness as to time; that 9:47 is not 9:40, or 9:45, or even 9:46, just as it must not be 9:48. It is 9:47. Neither a fraction of a minute more nor less. At home, in school, and in the positions offered in commercial life, there is more or less latitude; even the banks allow some leeway in the payment of notes. But in the operating department of a railroad, the clock which records the passage of time is the absolute monarch of action. And so the boy is taught exact-

ness, and has constantly in his mind the doing of the thing to be done at the precise moment when it should be done. Two or three years of this training indelibly fixes the habit; for example, in my own case, there is no reason why I should not now come to my office when I please; one day at 8, and the next at 10 o'clock. But I can't do it. I set 9 o'clock as my office hour, and when an occasional delay on the way down brings me there five or ten minutes late I feel all day like a train which has lost its schedule and is running wild. I have tried time and again to overcome this feeling, but I can't; it's too firmly fixed.

"However, as valuable as is this training, two or three years should be enough for any bright boy, unless he intends to make railroading his life work. In that time he will have learned the lesson which no college or university can possibly teach, or ever will, for the responsibilities of handling trains and the penalties for carelessness are things which cannot be bound in text books or delivered in lectures."

* * *

If the reader of these lines should write an advertisement of a lottery, and that advertisement should be printed in ever so small type in this magazine, we both would promptly be arrested, tried and placed in a United States penitentiary.

With unblushing inconsistency the Government has been conducting land lotteries on a large scale during the past few months. Whether or not any better method of allotting public lands could be devised matters little.

The amusing feature of the whole performance is the price the American public has paid for its chance. An amount of money, estimated at $20,000,000, was actually paid to railroads and hotels by the adventure loving army in their mad chase after a few hundred unimproved farms. When to this is added the value of the time spent the total is still larger. If the land seekers had joined in a common fund for the purchase of an equal amount of equally good land, the cost would have been reduced about 75 per cent, and every one would have had an actual ownership.

But then, there is no excitement in a sure thing.

* * *

Two years ago Popular Mechanics discontinued the use of all premium offers of any and every nature.

One year ago it withdrew from all clubbing arrangements and cut-rate offers.

We enter the year 1910 without one solitary subscription solicitor. Their work ended December 31, 1909.

Some of our readers may be interested in the reasons. The use of premiums encourages a class of subscribers—not necessarily readers—who subscribe in the deluded idea of getting, say, a knife worth $1.50 for $1 with the publication thrown in. The place to buy knives is at a store, not in a publisher's office. In no one establishment in the world is a good knife and a good magazine made together.

The clubbing offers are equally pernicious, illogical and illegitimate. The offer of $6 worth of magazines for, say, $4, is an admission that the publications are not worth the price stated as the regular subscription price. Those publishers, therefore, are unfair to their own individual subscribers, who are made to pay $1.50 for what in a club they can buy for $1. Hence, we do not "club."

The one place to get secure, lasting circulation is in the editorial pages. This latter is admittedly a process of much slower growth, but has proved itself to be more permanent. As for our two thousand subscription agents, their case is a peculiar one. During the past two years, and especially the last six months, a pest of swindlers have been abroad in the land. Their method was to purchase copies of this magazine on news stands, and collect subscription money from the innocent subscriber. After waiting several weeks the subscriber would write in, complaining he had not received his magazine. Investigation would reveal the fact that the alleged "agent" had made no report. In many instances this magazine has been blamed as being responsible. Time and again we offered a large reward for the arrest of the guilty parties, but without result. Therefore, the only absolute way to eradicate the evil seems to be to discontinue the use of all soliciting agents, and print a statement to that effect on the front cover.

The Patent Office is the one department of Government which actually yields a profit—something over $80,000 for the last fiscal year, during which the fees amounted to $1,887,000. While it would seem increasingly difficult to invent something which had not already been invented and patented, the records show 62,000 applications for mechanical appliances, on which 35,000 patents were issued.

Inasmuch as the past year shows an increase of 4,000 applications, it is evident that invention, instead of growing less, is on the contrary steadily increasing; and while many patents are secured on which the inventors realize little or nothing, yet fortunes are now and will continue to be made from new and practical ideas. In most cases the cause of failure to realize expectations will be found in the natural tendency of an inventor to magnify the possibilities and minimize the difficulties of selling his invention. While an occasional "find" is made by some one working along a line in which he is poorly informed, hundreds waste time and money developing some device which when finished proves to be either old or without demand.

If the inventor would have his attorney make a search of the records before instead of after completing his invention, he would save money and be able to work out his ideas along lines different from those already protected by patents.

* * *

Fresh air is a good investment, whether it be in the home, the office, or the factory. Without it the brightest mind beclouds and the most energetic grow listless and lose force. The human engine cannot develop its utmost power without fresh air, any more than a candle can burn brightly or the fire under a boiler yield its utmost heat when deprived of the necessary amount of oxygen. The Indian loses his vitality and the Esquimau speedily develops tuberculosis when made to live as the civilized live. It does not follow that we should wear a few feathers instead of tailor-made garments, or eat blubber and drink whale oil—which is largely a matter of taste—but we can be sensible and be as considerate of ourselves in our daily ration of fresh air as we are in selecting other kinds of food.

As a matter of ethics, there is little difference between breathing the impure air from our own and other people's lungs and bathing in the same tub of water that has served its mission several times. Of the two the dirty water is the least injurious.

Now, Mr. President and Mr. Manager who have few or many employes, what about the condition of the air these people have to breathe in your establishment? Have you ever looked into the subject? If not, don't you think it a good business proposition to do so? You would not pay them half good money and half bad, yet that may be the condition of the air you give them to breathe. You would not let a smallpox patient run among your men, yet impure air kills more every year. You would not think of putting strychnine in the water they drink, but poisonous air is as deadly, though less rapid, in its action.

Your men have cost you money, lots of it. They little realize how much time they have wasted learning to do things right, or the cost of material they have spoiled, or the machinery and tools they have injured or ruined before they found out how to use them properly. Having been to all this loss, isn't it worth while, from the most selfish of all motives even, to get the most production from them and to extend their usefulness as long as possible?

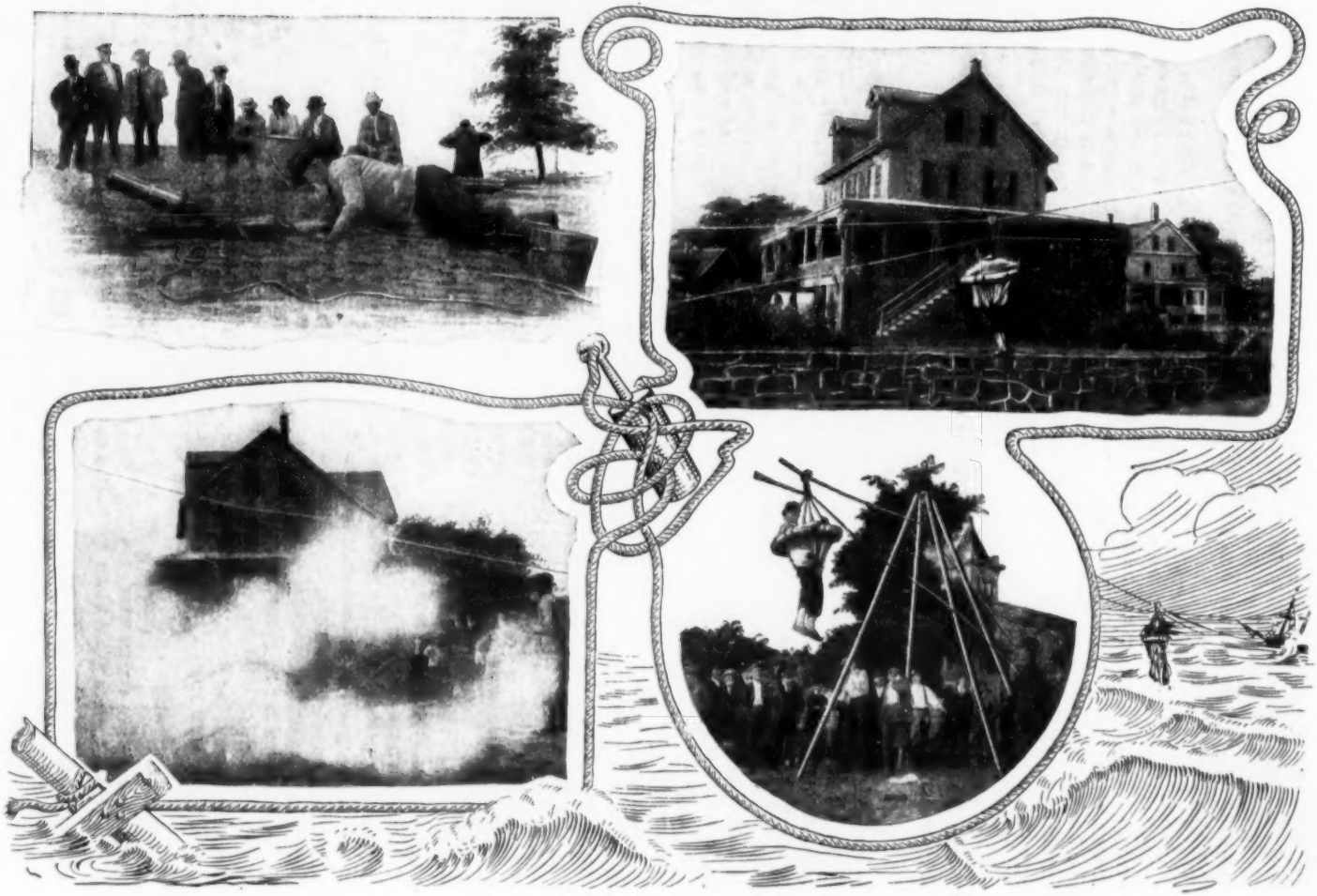
Better get out in your shops about 3 p.m. and see whether the air is dense and foul and the men slow and lifeless; if the hammer seems heavy in their hands; whether the boards are chasing one another through the planer or stringing out like the end of a funeral procession. There are plenty of visible signs waiting to tell their story of bad air, if you will go out and look for them.

Good air: good production.

Bad air: reduced production.

The twenty-five dollars which the "old man" sends with such pride to Jim's widow to help out the funeral expenses might better have been spent on ventilators.

H. H. WINDSOR.



Drilling with Breeches Buoy at Swampscott

PRACTICE WITH BREECHES BUOY

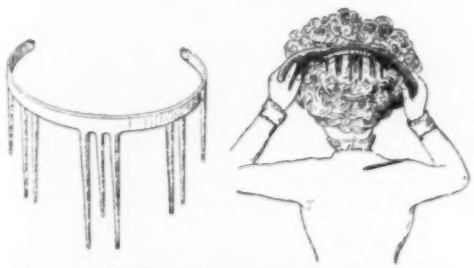
The accompanying set of illustrations shows four consecutive scenes in the breeches buoy drills of the volunteer life-saving corps at Swampscott, Mass. The practice is held within the town. Captain Gile, of Marblehead is shown in one illustration focusing the gun that projects the life-line; another was taken just as the gun was fired, and the remaining two show one of the crew being swung along in the breeches buoy and his arrival at the receiving end of the hawser.

Drilling with Breeches Buoy at Swampscott

BACK COMBS TO TAKE PLACE OF HATPINS

The advent of the large hat for women, with its attending evil in the form of long, wicked pins that endanger the eyes of all who approach to such an extent that prohibitive legislation has been urged, has been an incentive to French inventors in an attempt to find a practical substitute.

Such a substitute is shown in this illustration. It is a comb, the band of which is shaped to fit inside and at the back of the crown of the hat. Sewn or otherwise fastened in this position, it is worn and removed with the hat, its long and specially arranged teeth being pushed down into the hair in the same manner as the teeth of a side or back comb. When the hat is placed on the



Comb Substitute for Hatpins

head, the comb not only holds it there, but provides the same ornamental effect as does an ordinary back comb.

The Railroad Y. M. C. A. now has 245 associations and 178 buildings.

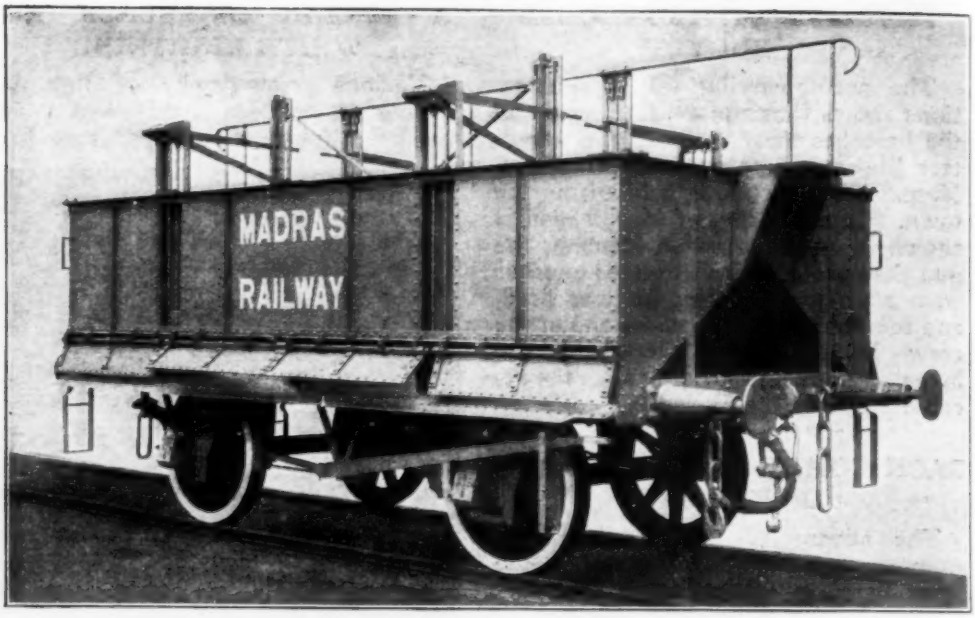
A STREAK OF BLACK AND WHITE LIGHTNING

Various photographs of lightning flashes have been made and many beautiful forms illustrated from time

An Unusual Lightning Photograph

to time, but the flash shown in the accompanying halftone engraving is a reproduction made direct from the original print of the first lightning flash in white accompanied by two black streaks that has been photographed. The black streaks were not visible to the operator's eye at the time of the exposure, but they showed up in the finished negative and print. As the negative was developed in the usual manner, the black streaks must have existed in some form to produce the effect on the sensitive plate.—Contributed by Allan S. Thompson, Lansing, Michigan.

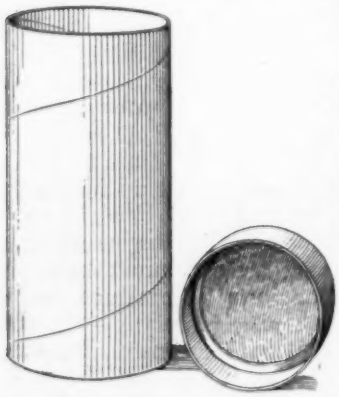
The common method of cleansing wool produces great quantities of foul liquors, containing valuable substances that can be recovered profitably. Among these are wool grease and crude petroleum.



Hopper Wagon, Madras Railway

SINGLE-SERVICE MILK BOTTLES OF PARAFFINED PAPER

The use of single-service paper milk bottles is being urged by sanitation workers in every part of the country, and such bottles are now being adopted in many of the larger cities. The New York milk committee is using such bottles in its seven infants' depots, and there seems no reason why they should not be generally adopted, not only for milk, but for oysters, butter, lard, and other articles of the grocery.



The bottles, one of which is shown in the drawing, are made of paraffined paper, sell for about half a cent each, and are thrown away as soon as emptied. Use of them, if they are only used once, eliminates the danger of infection always present in bottles passing through many hands.

That the glass milk bottle, used over and over again by different people, is a danger has been so far recognized by Boston that an ordinance has been passed imposing a fine not to exceed $10 for the use of one for any other purpose than for holding milk. It is directed at the consumers of milk who used the bottles for unsanitary purposes before sending them back to the dairies.

BLOCKS RIVER TO MOVE BUILDING

The moving of this large frame building across Black river in Springfield, Vermont, required no little skill and engineering ability. Contemplated improvements required the removal of the building and a contracting company bought it for a small consideration. A pathway of railroad ties, many feet high, was built up from the river bed, laid in such manner that the water

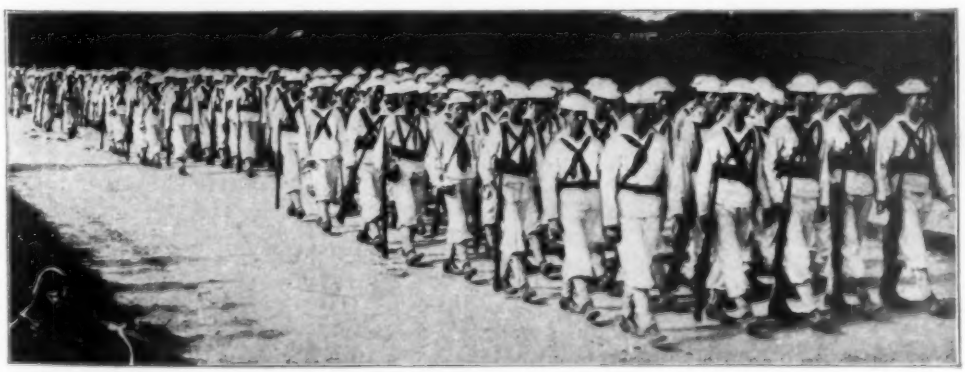
Moving Building Over Bridge of Ties

could find a passage through, should its sluggishness at that time of year be spurred into action by unforeseen conditions.

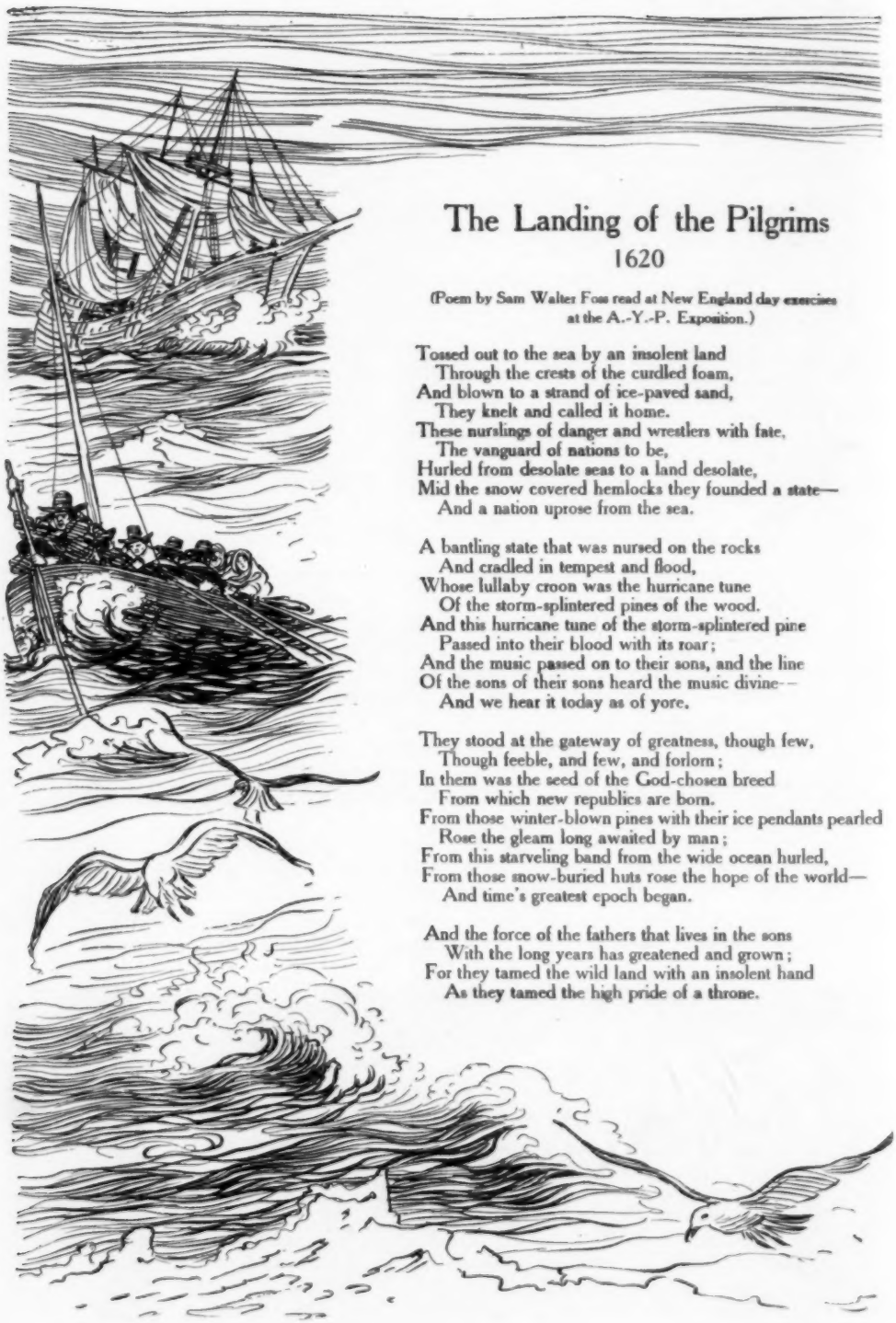
During the time the building was over the middle of the stream a severe rainfall threatened river activity that might carry the ties away and wreck the entire project in the high falls a short distance below, but the ties remained firm against the water and the feat was successfully accomplished.

NEWPORT'S MOST FAMOUS DRIVEWAY AS DRILL-WAY

The reserves of the Newport naval training station do not confine their marching and drills to the parade grounds, but give public exhibition drills in the streets of that city. The photograph shows the reserves marching down "Ten-Mile Drive," Newport's most famous driveway. During these marches they sing patriotic airs and hymns.



Marching Naval Reserves in Newport



The Landing of the Pilgrims

1620

(Poem by Sam Walter Foss read at New England day exercises at the A.-Y.-P. Exposition.)

Tossed out to the sea by an insolent land
Through the crests of the curdled foam,
And blown to a strand of ice-paved sand,
They knelt and called it home.
These nurslings of danger and wrestlers with fate,
The vanguard of nations to be,
Hurled from desolate seas to a land desolate,
Mid the snow covered hemlocks they founded a state—
And a nation uprose from the sea.

A bantling state that was nursed on the rocks
And cradled in tempest and flood,
Whose lullaby croon was the hurricane tune
Of the storm-splintered pines of the wood.
And this hurricane tune of the storm-splintered pine
Passed into their blood with its roar;
And the music passed on to their sons, and the line
Of the sons of their sons heard the music divine—
And we hear it today as of yore.

They stood at the gateway of greatness, though few,
Though feeble, and few, and forlorn;
In them was the seed of the God-chosen breed
From which new republics are born.
From those winter-blown pines with their ice pendants pearled
Rose the gleam long awaited by man;
From this starveling band from the wide ocean hurled,
From those snow-buried huts rose the hope of the world—
And time's greatest epoch began.

And the force of the fathers that lives in the sons
With the long years has greatened and grown;
For they tamed the wild land with an insolent hand
As they tamed the high pride of a throne.

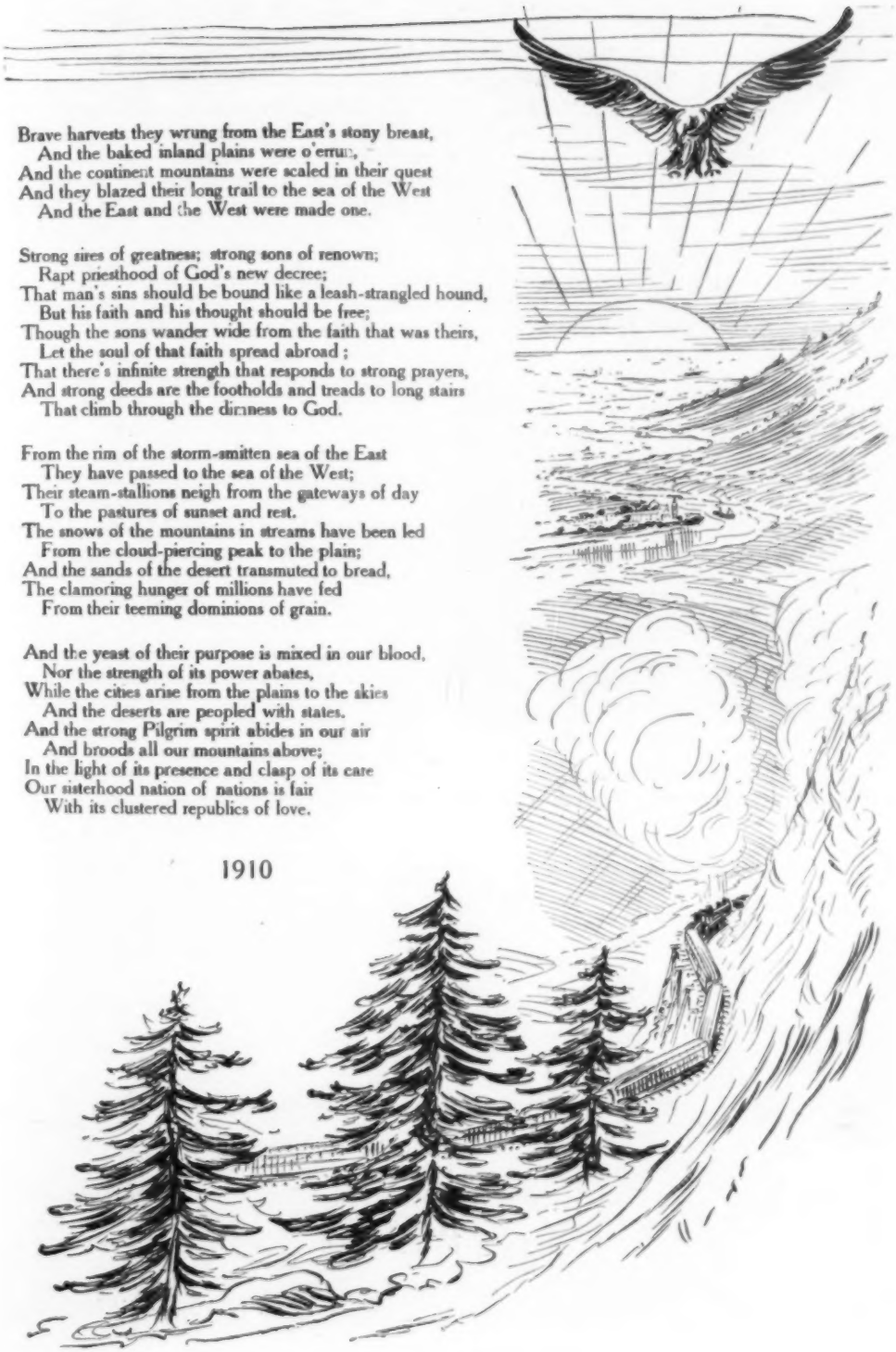
Brave harvests they wrung from the East's stony breast,
And the baked inland plains were o'errun,
And the continent mountains were scaled in their quest
And they blazed their long trail to the sea of the West
And the East and the West were made one.

Strong sires of greatness; strong sons of renown;
Rapt priesthood of God's new decree;
That man's sins should be bound like a leash-strangled hound,
But his faith and his thought should be free;
Though the sons wander wide from the faith that was theirs,
Let the soul of that faith spread abroad;
That there's infinite strength that responds to strong prayers,
And strong deeds are the footholds and treads to long stairs
That climb through the dimness to God.

From the rim of the storm-smitten sea of the East
They have passed to the sea of the West;
Their steam-stallions neigh from the gateways of day
To the pastures of sunset and rest.
The snows of the mountains in streams have been led
From the cloud-piercing peak to the plain;
And the sands of the desert transmuted to bread,
The clamoring hunger of millions have fed
From their teeming dominions of grain.

And the yeast of their purpose is mixed in our blood,
Nor the strength of its power abates,
While the cities arise from the plains to the skies
And the deserts are peopled with states.
And the strong Pilgrim spirit abides in our air
And broods all our mountains above;
In the light of its presence and clasp of its care
Our sisterhood nation of nations is fair
With its clustered republics of love.

1910



THE BREAKWATER AT HILO, HAWAII

In 1908 the United States entered into a contract for the constructing of a $400,000 section of the breakwater at Hilo harbor, Hawaii, illustrations of the progress of which are here shown. The work has progressed something over 1,000 of the 2,500 ft. provided for by the present contract. It has a top width of 15 ft. When the entire breakwater is completed, the cost will have reached something like $1,700,000, and its length will be 9,700 ft., beginning at the shore and extending out across the opening of the bay upon a submerged reef. It will enclose and protect from the northeasterly swells a body of water approximating 3,000 acres, and will make one of the finest deep-water harbors in any ocean.

Breakwater Crane in Operation

One of the greatest interests of Hilo is its railroad, the only one of broad gauge in the islands. It operates 50 miles of main line, and gives access to 40,000 acres of fine agricultural lands. It operates its own car shops, machine shops, and foundry, and employs 300 men, paying out $100,000 a year in wages and salaries.

An extension of the road through the district of Hamakua is now being constructed. An idea of the magnitude of the project, great when it is considered that the island is only 90 miles long by 74 miles wide, is gained from the fact that the first 15 miles will cost $700,000.

Hilo Breakwater, 995 Ft. Long

GREAT STONE MONUMENT IN MORE POWERFUL ANEMOME-

The traveler, coming into Hilo by steamer, will pass through wonderful scenery on this extension. The trains will disappear at times in the vast canefields, only to come into view suddenly when crossing deep ravines.

An entirely new industry on the Island of Hawaii is that of a lumber concern, which is turning out 2,500,000 cross ties for the Santa Fe railroad. It also turns out lumber and other products for which the demand is continually increasing.

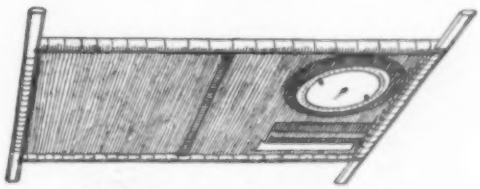
Hilo is the principal town of Hawaii and the second largest in the Hawaiian group. It has a population roughly estimated at 5,000, and in the country surrounding it are about 27,000 more.

BASEMENT FURNISHES MATERIAL FOR BUILDING

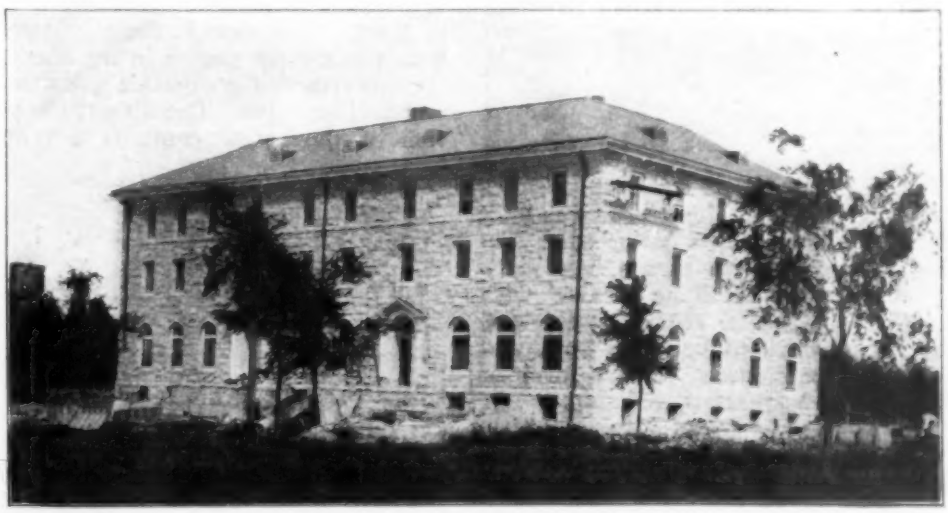
The illustration shows a building that has risen out of the very ground on which it stands. The building is the new dormitory of the Rhode Island State college and the walls of the entire structure have been quarried from the ground on which the building stands. The foundation has been built on the same ledge of granite that the walls are made of, so that, with the exception of the roof, the basement and walls represent a homogenecus construction throughout. For this reason the building was constructed for a very reasonable price, the contract figure being $37,000, and is, in fact, the most economically built state or municipal building in the state. The building accommodates and provides eating halls for 100 students.

AN AVIATOR'S COMPASS

A device, which is to direct an aeroplane in the same manner as a compass directs a ship, has been invented by an Englishman. It is an ingenious combination of the sundial and the compass, and is known as a "shadow-plate." Its dial is of celluloid, and in the center is a small pin that throws a shadow as the light passes through. When it is fixed to the forward part of the upper plane of the aeroplane, the aviator can tell the course he is taking by the variations of the shadow.



Shadow-Plate Director for Aeroplanes



Building Site Furnished Construction Material

GREAT STONE MONUMENT IN FORM OF SAILS

This towering monument, one of the most unique in the world, stands on a

Sails of Stone

hill at Guatalupe, Mexico. It was built many years ago by a sailor who, during a severe storm at sea, vowed to erect a monument if he escaped with his life. When he reached solid land he set to work to keep his vow, and built the monument in the form of the sails of a square-rigged ship.

The Saracen's Head hotel, London, immortalized by Charles Dickens, has closed its doors forever after a life of 400 years.

MORE POWERFUL ANEMOMETERS REQUIRED

The fact that the present type of anemometer has proved unable, in one instance at least, to withstand the pressure of great storms has led Willis L. Moore, chief of the weather bureau, to turn his attention to the construction of a machine on a new principle, designed to withstand any storm.

The record storm in the United States was that which caused death and destruction at Galveston, Sept. 8, 1900. At that time the anemometer marked 135 miles an hour, and then was blown to pieces as the velocity of the wind increased above that figure. In September of last year a typhoon which swept over the Philippines reached a velocity of 135 miles an hour. The anemometer stood this pressure, but had the wind reached a velocity slightly greater it would have followed the fate of the Galveston anemometer.

HERMETIC SCREW-CORK FOR BOTTLES

The moment a bottle of wine or other gaseous beverage has been opened, the contents commence to be affected by contact with the air, and, unless some means be provided by which the bottle can be again hermetically sealed, cannot be kept any length of time. This device, the working of which is clearly shown in the illustrations, hermetically re-seals a bottle of any ordinary size. The disk at the bottom of the screw contains a rubber

Hermetic Bottle Seal

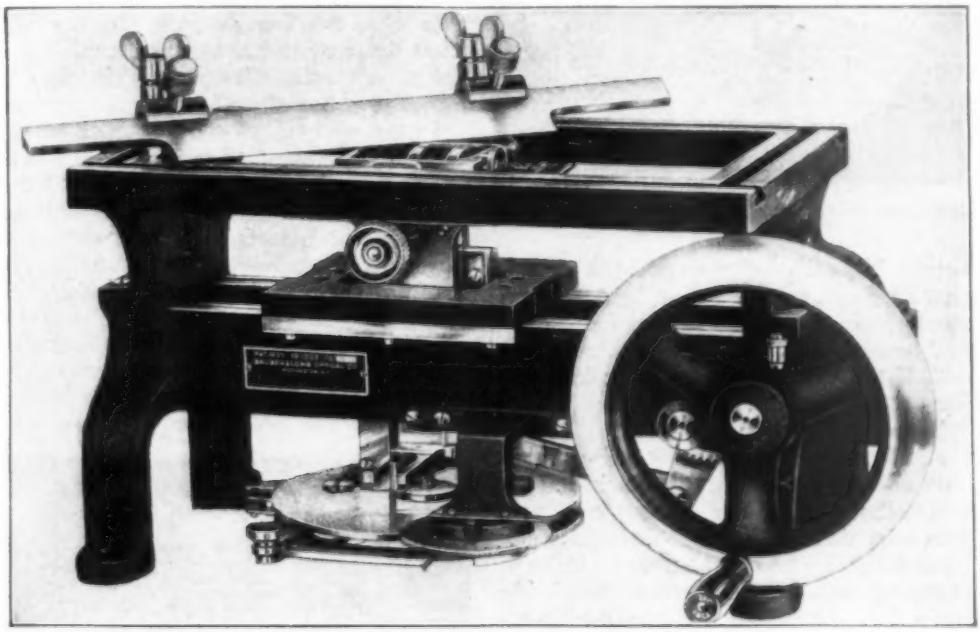
ring which is forced tightly down over the head of the bottom by turning the screw.

MICROTOMES AND MICRONS

Remarkable Instruments Which Cut Sections One-Twenty-Five-Thousandth of an Inch in Thickness

By C. H. Claudy

"Splitting a hair" is common parlance for a delicate operation. But if the scientist had to stop with the half of a hair for fine microscopical work, he could not delve very far into that curious universe of the infinitely small which is all about us and, to most of us, as little known as that other vaster universe which we call cosmos.



Most Elaborate Microtome Which Cuts to One Micron with Knife in Any Position

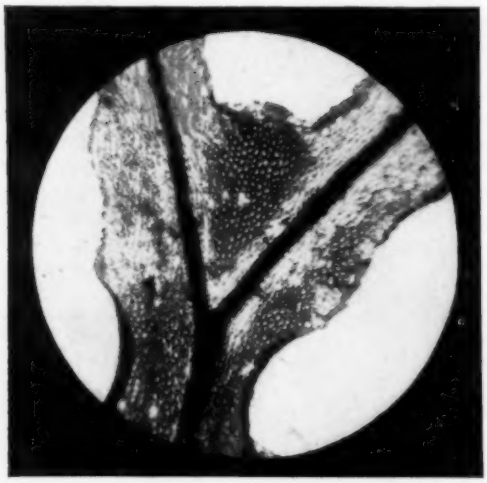
An elephant is rather ponderous—until you see him beside the Singer building. The entomologist who impales it must look large to the butterfly, and it, in turn, is big compared to the head of the pin which holds it.

Yet a pin head is a huge mass compared to those tiny cells which the microscopist seeks to understand, be he histologist, pathologist, bacteriologist, botanist or biologist. As much greater as the tallest building than the elephant, as much greater as the biggest elephant than the man, as much more huge the man than the butterfly, and the butterfly than the head of the common pin, so the pin head to the smaller cells.

Excellence in anything is to be desired, but too great a degree of perfection may be more a power for harm than good. Selling sugar by the pound, it would boot the grocer little to use a balance weighing to the grain. It would embarrass the shopman to measure cloth with an ice-bar. Had all drinks to be sold from a burette, the cause of the White Ribboners would be won without further fighting.

Of what service a microscope with

mechanical movements fine enough, and lenses powerful enough, to halve the micron, if there be no microns to



Microtome Cross-Section of Flesh from a Cat's Toe, Showing Join in Veins

split. Why a power so great, a definition so clear, a penetration so deep that the eye of science can see into and over and around and beneath and through a cell, if the cell itself cannot be isolated for study?

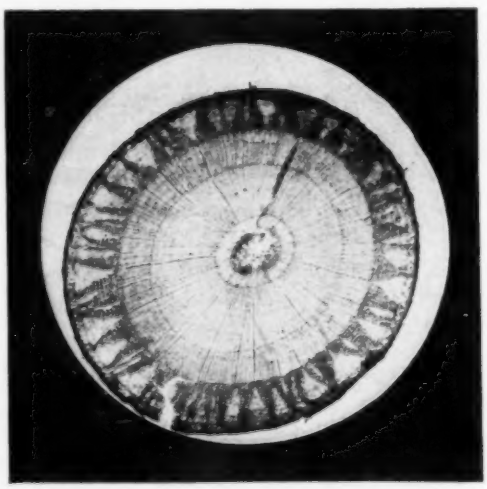
Therefore, the microtome.

A microtome is an instrument which cuts slices. So is a bread machine in a restaurant. But the microtome cuts slices so thin, so fine, so infinitely attenuated, that comparisons fail in carrying the idea to the brain. To write,"one-twenty-five-thousandth part of an inch" is the easy way out—but what do the words mean to you? Nothing. To define a micron as the thousandth part of the thousandth part of a meter is absolutely accurate and about as illuminating as a wax vesta in an opera house.

Divide an inch into one hundred parts, and you will have good eyes if you can readily see one of them. Divided into a thousand pieces, you could not see three placed side by side, look how you might. Divide *one* of the three which you cannot see into twenty-five parts. Say to your mechanician, "Make me a machine which shall cut me a slice of tissue this thickness all over, and cut me a dozen, a hundred, a thousand such slices, the one after the other, never missing, never skipping," and see what he says!

Yet so Science, hardest taskmaster of those who follow Knowledge wheresoever she may lead, be her lairs never so small and so remote, has said to Brains, and Brains has gone to work and cut and chiseled and tried and failed and invented and proved and disproved and worried and worked and contrived and constructed, and now, behold, there *is* an engine which can take material and slice it into pieces so thin that no human eye can see the edge thereof, and then, a veritable marvel of marvels, slice from this piece a hundred other slices!

In the early days a microtome which would cut twenty-five microns was a very fine instrument indeed. Now twenty-five microns is the coarsest cut of a fine instrument. To be sure, the necessity for a finer slice of any tissue was not then so apparent as today, because the microscope had not yet taken its place among truly scientific tools. A good microscope objective was still a matter of trial and error, and Abbe, father of the modern microscope, had

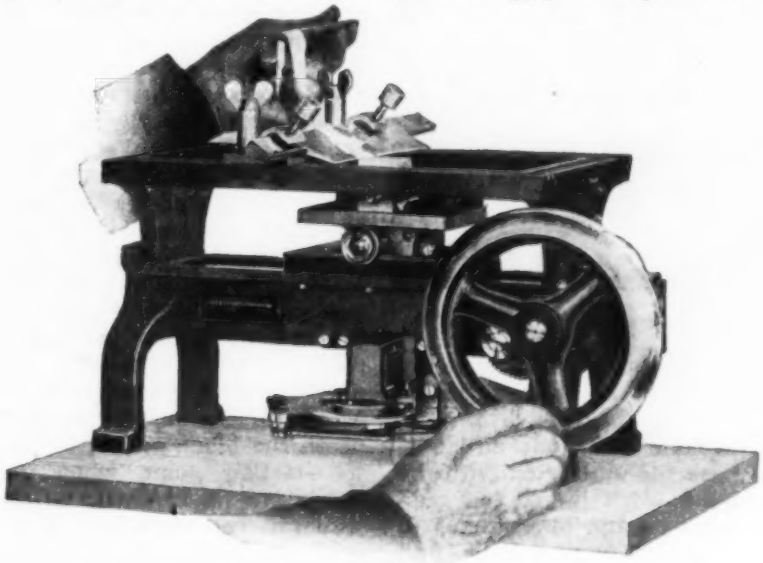


Vein of a Lily Pad, Microtome Cross-Section

yet to bring before the world his startling ideas, the fruition of which is seen today in the strides forward of every science which depends upon the tiny

lens of the microscope for the truthful delineation of the facts collated from which laws are deduced.

Accurate, rigid, reliable—reliable, rigid, accurate! These are the words which have sung in the ears of those who would make the microtome keep the pace the microscope has set. That the microtome of today is the mechanical equal of the most modern and perfect of stands, and is as accurate as the most highly figured, ground and polished oil immersion objective, is the triumph of its manufacturers.



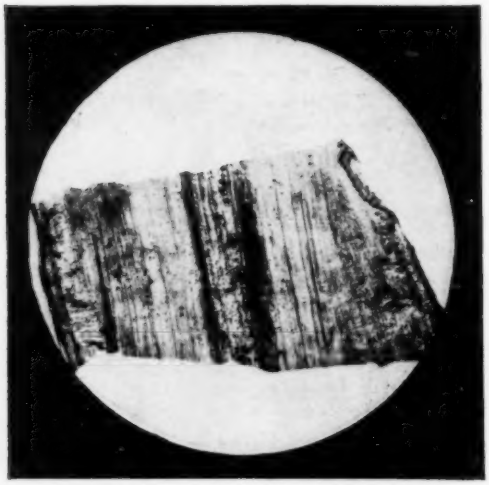
Using Minot Precision Microtome and Pulling Off a 5-Micron Section

It is well that it is so, for, as in all departments of human activity, the perfection of the unit depends upon the perfection of its neighbors. The greatest of buildings is a failure if the foundation be not strong, the most elaborate safety device is useless if the intelligence which operates it is weak, the most careful surveys may miss by a mile the accuracy which should be measurable in inches, if the transit, the tables, and the calculations of the engineer are not equally precise and dependable. The microtome, even as the microscope, is an engine of precision. Were the microtome less perfect, the microscope would be less useful.

In the early days microtomes cut unevenly, they skipped, they chattered, they cut sections too coarse to get down to the vision of the single cell, they wore out, they were unreliable, they couldn't cut long series of sections. To make a microtome which was to be depended upon, to make one which would always cut and cut evenly, no matter how many sections might be demanded of it, to make one which would cut sections today, yesterday and tomorrow of the same unvarying size, to cut sections of such a minute thickness that mental conception stops with naming it, but which would allow the microscope to make visible that which is ordinarily, even under the most powerful lenses, invisible; to make this instrument with an accuracy so based on correct mechanical principles that it would last under wear, and to remember always that in an engine the smallest movement of which was to be the unheard-of fineness of one micron, no error of more than that amount in any part of the construction could be considered—this was the ideal.

Today, those microtomes designed by and bearing the name of Dr. C. S. Minot, the greatest living authority on sections and sectioning, stand alone among such instruments, the only ones

of their kind in the world. There are other good microtomes, but the Minot precision is, par excellence, the most



Longitudinal Cross-Section Ring of White Pine

complete, most elaborate and, save only the Minot rotary, the most accurate sectioning machine in the world.

Go into any one of a thousand laboratories and ask the quiet men with the keen eyes who work there, and read the nameplates on the microtomes to which they point: You will find "Minot" wherever you have been told, "That is the best."

What are they like, these microtomes? Examine a large one and you will see an oblong steel frame supported on four legs. The top of the frame is channeled to allow the clamping of the knife in any position. Beneath is a delicate engine, the heart of the microtome, to the pulse beats of which the clamp with the object to be cut moves slowly to and fro and ever upwards—upwards so slowly, so finely and yet so surely that with each passing of the object against the knife blade a section is sliced off, beside which any slab "wafer thin" becomes monumental.

And this apparatus which moves the clamp? A wheel, two gears, a crank, a cam, a smaller, lighter wheel bearing on its periphery five hundred accurately milled, fine, saw-like teeth, a clicking pawl to pull it, and an axle which is a screw. On the screw is a special kind of nut, which carries the clamp or disk holding the object. As the flywheel is revolved, the carriage advances and the object is brought against the edge of the delicate, perfect knife above. A section is cut and the carriage returns. When the carriage is clear of the knife, the hardened steel roller on the pawl lever comes in contact with the hardened steel cam, makes a stroke, the pawl pulls on the teeth of the wheel, the screw makes a part of a revolution, and the nut raises a tiny fraction of an inch, bringing the object again slightly above the plane of the knife's edge. Simple? Yes, as are all accurate mechanisms, but in that simplicity lies the alpha and omega of the mechanic's art.

The original invention, manufacture, and perfection of the split nut on the screw marks one of the greatest improvements which has ever been effected on the microtome, bar none. It provides a ready means of moving the clamp for the object up and down beneath the blade and of returning it to its starting point, when the end of the screw is reached, without going through the tiresome and wearing process of screwing it down. A small release lever allows the split nut to clamp the screw anywhere along its length. The threads on this screw are very, very fine and very, very delicate. A complete revolution of the axle bearing the thread advances the clamp upwards by the half of a millimeter. It is by this delicate screw and its extreme accuracy, the equal delicacy and accuracy of the teeth upon the edge of the wheel which moves the screw, and the absolute perfection of the compound curved steel cam, the radius of which at a given point determines the length of the stroke which pulls on the toothed wheel, that so infinitesimal a movement as one micron is obtained with real accuracy. The less wear there is upon the screw, the longer it will remain accurate; the less it has to move in the threaded socket of the clamp, the less wear there will be. Consequently the split nut which removes half the wear

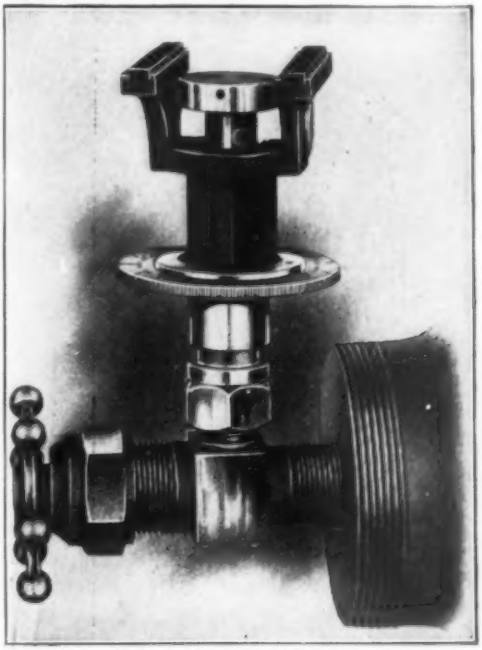
on the thread increases the life of the vitals of the microtome, the screw, by exactly one hundred per cent. Moreover, the saving in convenience and in time makes it less likely that injury and accident come to the delicate mechanism from a too hurried return of the screw, had it to be worked down.

This same human penchant for hurry has made it necessary to have the large microtomes geared down, so that there are, for instance, three revolutions of the flywheel necessary for any one complete stroke of the carriage. If the gearing is direct, in a mechanism which moves so easily and smoothly, the tendency is to hurry; and hurry, particularly in large work, is fatal both to good sections and knife edges. By gearing down, and having a perfectly balanced and heavy flywheel, the very spirit and essence of smooth, even motion results: so smooth, so easy and so provided with momentum without haste that, even with a tough section, there is no jar to machine, to preparation, or to knife edge.

Rotary microtomes differ from the horizontal ones in that the knife is held vertically, and the clamp moves up and down and not back and forth. They are more compact, less adaptable, but just as efficient engines, with the same escapement, the same cam, the same wheel and screw and split nut of their larger brothers.

In the yesterday of laboratory science and the making of microtomes, the cutting of one or two very thin and perfect sections was an achievement. Now a laboratory microtome which cannot make a ribbon of sections for serial examination is not considered as a real microtome at all, merely a substitute for elementary student use until skill and knowledge gained make the acquirement of the better instrument a necessity.

Serial sections and the art of cutting them have been brought to the present state of perfection largely through the perfecting of the instrument. For long they were merely a dream. Now an expert operator can take a mosquito, for instance, properly imbed it, and make hundreds of sections in series, so that a student may see, in their proper order, exactly the arrangements and



Burdeen Freezing Microtome

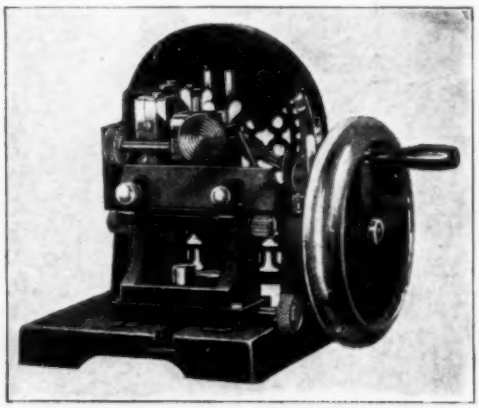
Knife to be used in the hand, attached to CO_2 cylinder for freezing and sectioning morbid tissue during operations in hospitals.

construction of the inner marvels which make the unpopular pest so interesting scientifically.

Such work depends largely upon the workman. It takes years of training to make an expert microscopical technician. But, no matter how expert a man may be at infiltration and the preparation of microscopical objects, no matter what his care and pains to have good sectioning conditions at hand when he works, if his instrument is not vibration and lost-motion proof, he will have worked in vain.

The absence of lost motion in the slides of the knife blocks and in the slides of the carriage holding the object clamp or disk, is secured by a V-shaped slide, in which the moving parts work. So accurate is the fitting—as accurate as in the making of the adjustments in the finest microscope stands—that after milling and machine polish-

ing the parts go to a trained and skilful workman, and not until the sensitive eyes in the ends of his fingers have told him over and over again that the two fit as if they grew together and



Rotary Microtome with Stationary Knife

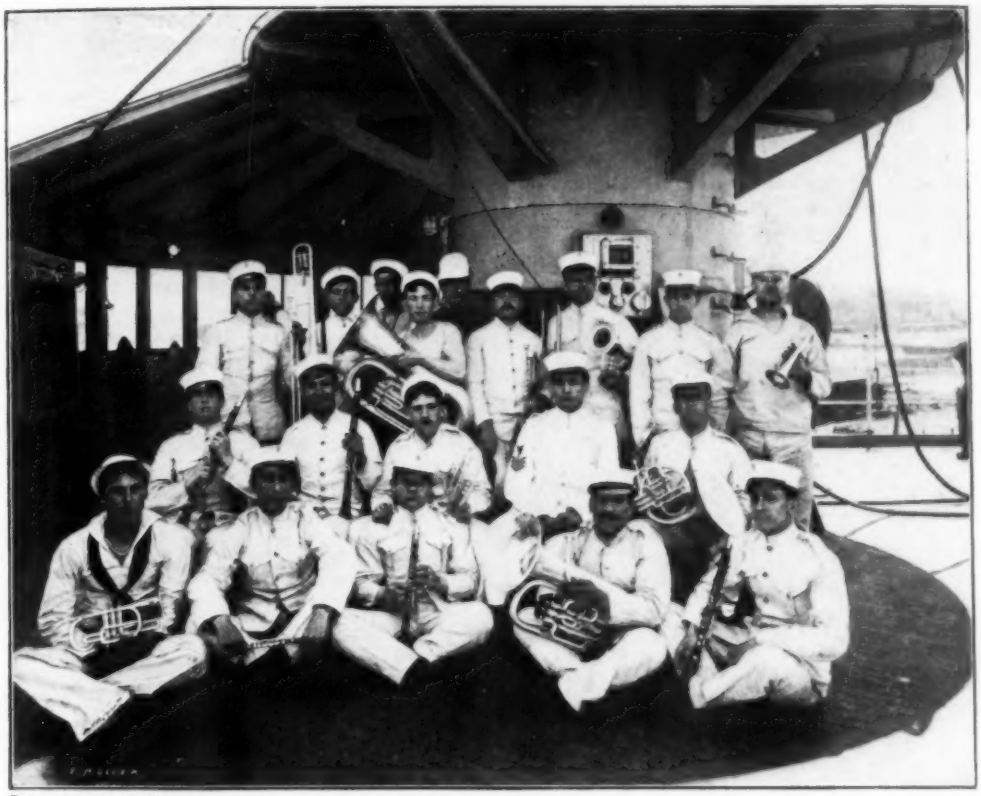
that movement from end to end is without hitch or jar does he pass them on to the inspector who verifies his work.

No tool of science is more perfect than its least perfect part. The finest microtome would be a failure if the knife which did the cutting were less perfect than the screw which feeds the object. Microtome knives are expensive, not only because of the great care which is required to make them, but for the number which are thrown out in different stages of manufacture, very much as in the making of fine lenses. After forging and grinding in the rough, and the finer, second grinding, a flaw in the steel may make its appearance. If so, that much work wasted; if not, fine grinding next, after which the steel is tempered again and again. Sometimes a blade will warp and twist and bend in the process—such knives are never finished. More grinding and then finishing, which means a final sharpening on glass with diamantine powder, in which the weight of the knife gives its only pressure. The requirements of a microtome knife, which throw five out of every twelve in the scrap heap during the process of manufacture, are not only perfect steel, perfect "teeth" and perfect edge, but absolute straightness of the edge, which must be the lowest point of the knife blade as presented to the object. This means a wafer edge, a very, very thin one, and one which is of continuous steel and not the "wire edge" of boyhood grindstone days. With all these necessities hedging the manufacture of the knife and the further one that it must be made to scale, it is small wonder that they come through but five out of twelve!

The finest cellular structure can be made visible under the microscope with sections a micron thick. Modern medical and surgical science tends more and more to the conviction that on the study of the cell and what it is and does and how it does it, what may and does happen to it, and how its efforts and usefulness may be changed and directed at will, depends the future of those branches of science which alleviate and prevent human suffering. Many a patient on the operating table has supplied morbid tissue for rapid sectioning on a freezing microtome, that those who strove with the last bulwark of mankind against disease and death —the dreaded surgeon's knife—might know exactly what they did and why and where and how far to go. We know, most of us, that it is to the microscope and the men who use it so well, and thus to the men who make it and who put science and knowledge first and material reward second, that we owe the successful war we have waged against so many curses of mankind. Side by side with the microscope, and, in certain work, as essential as the wonder showing tube, is this cutter of thin slices.

If the microscope can be called the most powerful eye of science, surely its deftest hand is that instrument which makes it possible to see the cell upon which all life and all disease depend—the microtome.

All Cuban and Mexican postoffices competent to issue money orders may now issue on postoffices in the other country, the agreement being similar to that between Cuba and the United States.



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LIFE IN OUR NAVY—No. 6, U. S. Band on the "New Hampshire"

ELECTRICALLY-OPERATED REVOLVING DOORS

The revolving door, introduced for stores, hotels, and business buildings in an endeavor to keep out as much cold air as possible, proved rather heavy to be pushed around, especially by women. A great many such doors, however, are now operated by electric motors, and the people entering or leaving the building are not required to exert themselves.

The systems being adopted allow the motor to be run by push-button, which permits the doorman to start and stop the door as desired, or, when no doorman is in charge, to run all the time so that the door is continually revolving.

The motor is usually mounted on the framework above the door, and is belted to a pulley wheel operating a small spur wheel, which, in turn, engages a larger spur wheel keyed to the center axis of the door.

THE WETTEST PLACE IN GREAT BRITAIN

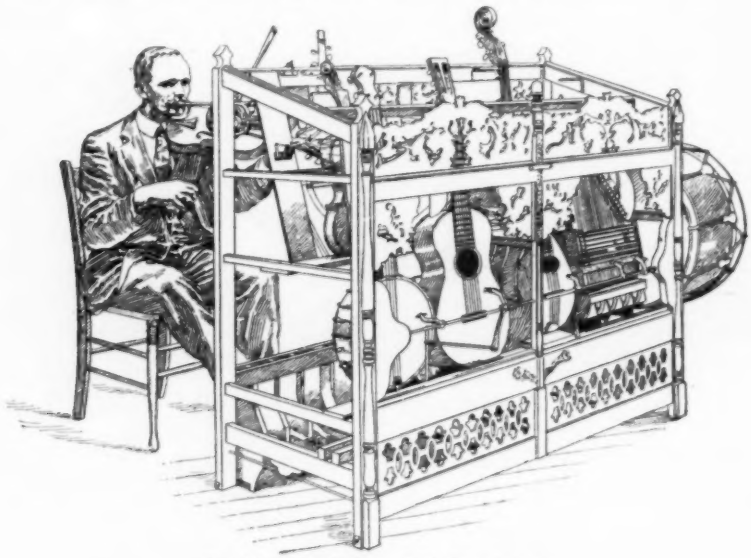
Snowdonia, Wales, is given credit for being the wettest place in Great Britain, by reason of 237 in. of rainfall in 1908. The gauges, placed on a grassy slope 1,480 ft. above sea level on the Snowden side of Llydaw, and examined each day at 9 a. m., gave the above number of inches of fall for the year.

Previous to this report, it was always considered that the Stye, at the end of Borrowdale, Cumberland, was the wettest place in England. The average annual rainfall at that point is about 170 in.

INGENIOUS ONE-MAN ORCHESTRA

Many a mechanically inclined musician has devised means by which he can play three or four instruments at the same time, but this one-man orchestra is one of the most complete of the kind, its inventor having spent eight years in perfecting it.

The instruments are a first violin, second violin, bass violin, banjo, guitar, mandolin, autoharp, cornet, cymbal, triangle, and bass drum. Nine of these he plays with his feet, which operate mechanical devices. He plays another with his hands, and the last of the series, the cornet, he plays with his mouth, although its valves, or keys are operated by levers connected with a foot pedal. Six pedals are used in the playing of the instruments.



One-Man Orchestra of 11 Instruments

AEROPLANES MAY FLY 1,000 MILES AT GREAT SPEED

The aeroplane, according to a statement made by Wilbur Wright, based upon his present experience and knowledge, will be developed to a point where it will be able to fly 1,000 miles without landing, attain a sustained speed of 100 miles an hour, and carry six persons.

Such a development might be expected to cause a wonderful change in the world's affairs. Mail could be delivered in one half the time, business men could go from Philadelphia to New York as quickly as they now travel from New York to their suburban homes, and another great leap would be made in the shortening of time. The real question is, however, how many years will elapse before business men will trust themselves to aerial transportation.

ANCIENT BUT STILL ACTIVE HUDSON-RIVER BOATS

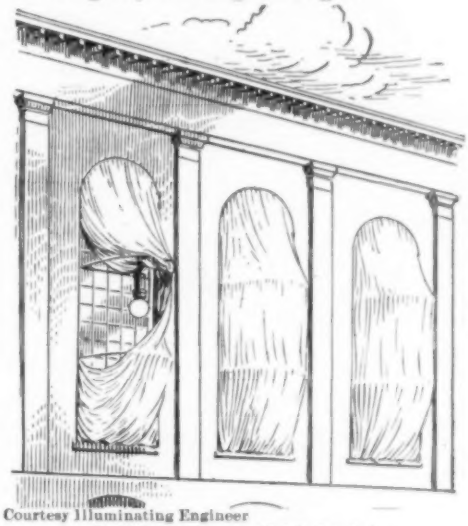
It is probable that no body of water in the world can boast of older boats still in service than the Hudson river, the stretch of waterway on which the "Clermont," the first of successful steamboats, made its early voyages. In addition to the "Norwich," built in 1836, already described in this magazine, are two other old vessels that are still run at a profit. One is the "Air Line," a ferry boat that makes daily trips across the river at Saugerties. She was built in 1853. The other is the "Mary Powell," better known as the

"Queen of the Hudson." She was built in 1861, and still plies the river during the summer months.

It is likely there are several others still in commission that were built 60 or 70 years ago.

ARTIFICIAL SUNLIGHT ILLUMINATION IN CHURCH

Artificial sunlight, as part of an evening wedding illumination, was recently produced in a church at Montgomery, Ala., in a manner truly as ingenious as it was original. A canvas hood was placed over the outside of four of the church windows, and in these hoods and a couple of feet outside the glass of each window was hung a flaming electric arc. At the beginning of the ceremony all the lights in the church were turned out and the flaming arcs turned on. The result of the light streaming through the stained glass was like that of sunrise, then, gradually the lights inside the church were turned on and the soft mellow glow slowly changed and became more intense, as if the sun was brightly shining through.



Courtesy Illuminating Engineer

Source of the Artificial Sunlight

The illustration shows the manner of arranging the arcs and hooding them.

GALLOPING AMBULANCE TESTED IN MANEUVERS

During the army maneuvers attending the advance upon and the defense of Boston by the so-called Red and Blue armies, the galloping ambulance here illustrated was given several tests. It is a light, 2-wheeled cart, the body of which rests on elliptical springs. It has a light canvas top, curtains that can be lifted or rolled up, and a canvas stretcher which slides in under the hood. A number of set stakes are also provided on which a canvas strip can be stretched to make a cot for temporary field operations.

Ambulance That Is Galloped Over Rough Ground

Contains the Bones of Founder of Buddhism

SEVEN-INCH CASKET HAD HUGE TEMPLE

One of the most important discoveries of religious relics in the past few years was the recent finding of a casket actually containing the bones of Gautama Buddha, the founder of Buddhism, at Peshawar, in Northern India. This relic was so sacred to the faithful that the Emperor Kanishka built the most splendid temple in India for its housing, about the time of Christ.

Although the casket, which is represented in the illustration, is only 7 in. in diameter, the temple for its housing was nearly a quarter of a mile in circumference. The temple, under the stress of centuries, crumbled to ruin, and the whereabouts of the casket became a mystery until found at Peshawar.

TRANSPORTATION OF GREEN TOBACCO

The tenderness of green tobacco, and the consequent care involved in its handling and transportation from the fields has caused a wagon of this type to come into general use in the tobacco belt of Tennessee and Kentucky. It consists of a light frame on wheels, on which many crosspieces are placed for the suspension of the tobacco leaves. By this method the tobacco hangs perfectly free and crushing is impossible, unless the frame is overloaded.

Bottomless Wagon for Transport of Tobacco Leaves

THE FISHERMEN'S HOSPITAL SHIP

Attention was drawn in a recent issue of this magazine to the wonderful work of the French hospital ship which serves the fishermen on the Quero fishing bank, irrespective of their nationality or creed. The ship, which is the "St. Francois," of Havre, is shown in the illustration. She is the only ship following such a mission among fishermen.

"Good Samaritan" to the Fishermen

CORN THEORY OF PELLAGRA

Pellagra, a malady affecting the skin and accompanied by severe constitutional and nervous symptoms, constantly present to a greater or lesser extent among the lower classes in Northern Italy, has been found recently in several severe cases in Illinois and the South. The rapid spread of the disease in certain sections brought it sharply to public attention, and, as a result, many physicians announced that it was caused by the eating of cornbread and other corn products.

This theory, however, is not altogether accepted. At the Bartonville asylum near Peoria, Ill., with its several cases, no evidence was found to indicate that corn was responsible. Also, in the case of Mrs. Barto, one of the most typical cases of pellagra in American medical records, corn had never been eaten in any of its guises. A study of this case, and a close comparison of it with a very similar disease of the Philippines, called sprue, has led to the belief of one expert that it is a malady of the leprous group, a microbic disease, perhaps aggravated by altered corn, but not caused by it.

Starboard and Port

REMARKABLE PHOTOGRAPH OF THE "ZEPPELIN"

This photograph of the dirigible airship "Zeppelin," taken when she was descending from a great height, makes her appear to be shooting almost straight downward like the spent head of a great skyrocket. In reality the angle of descent is greatly exaggerated by the photograph, but it gives an excellent idea of how she looks when maneuvering high in the air.

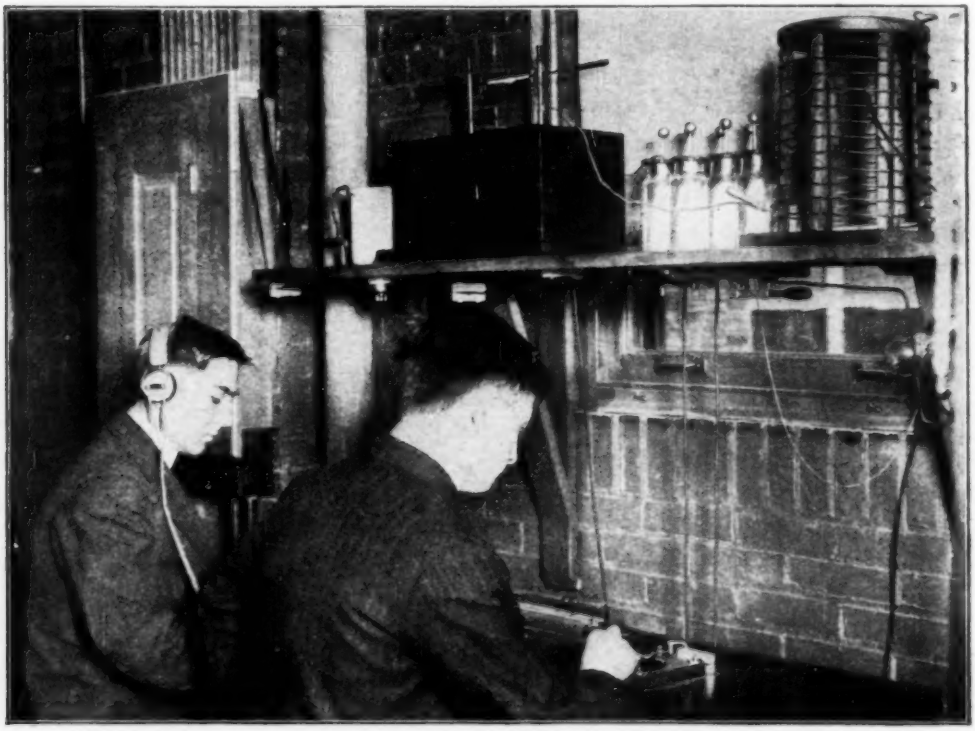
It is claimed that the turkeys of New England are being literally wiped out by appendicitis.

ST. LOUIS SCHOOL HAS WIRELESS STATION

The principal high school in St. Louis has for the past few months been able to boast of being the only school in that part of the country to have a practical wireless station as part of its educational equipment. Already, a half dozen of the students have become quite proficient in the Marconi system, and it is expected that they will soon be in communication with stations in many cities as far distant as Chicago and Kansas City.

The apparatus has a primary and a secondary spark coil capable of 120,000 volts, producing a 3-in. spark; a battery of eight Leyden jars for storing the electricity and preventing "damping" of the waves, and a "tuner" for decreasing and increasing the strength of the sound waves.

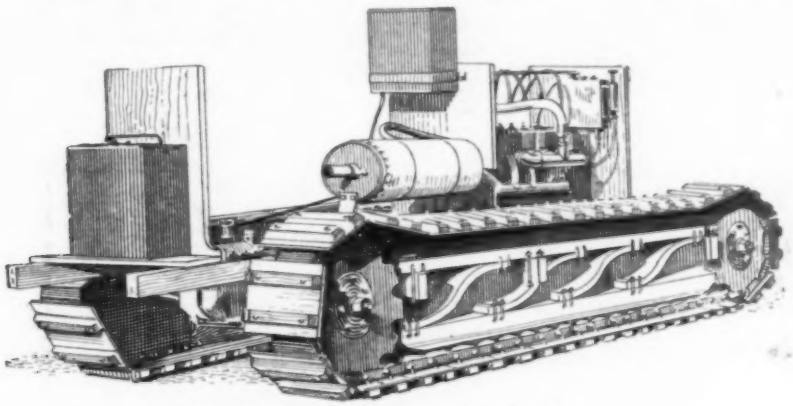
Other municipal schools in different parts of the country are considering adding this new branch of learning.



St. Louis Students Sending and Receiving Messages

CAPTAIN SCOTT'S ANTARCTIC AUTOMOBILE

The automobile which Captain Scott, the famous English explorer, is taking with him in his attempt to reach the South Pole, is shown in this illustration. It embodies the same principles as the so-called caterpillar type of machine, illustrations of which have been published in previous issues, and its greatest feature for polar travel lies in the fact that it practically carries its own road in the chain of blocks. These run over and under its wheels in the same manner as a belt over a set of pulleys, thus making passage possible over rough ice.



May Carry Its Own Road to South Pole

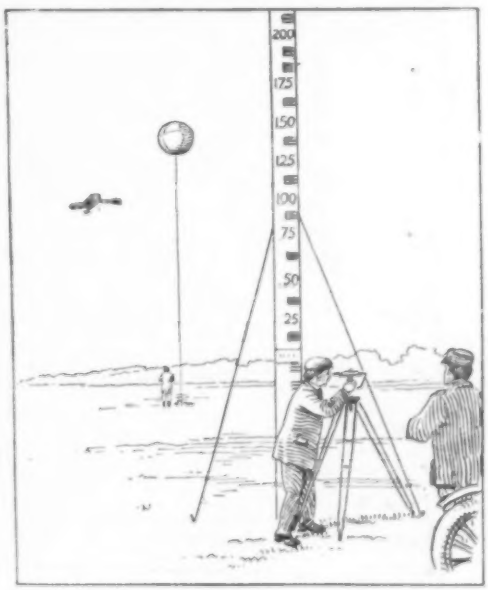
BRAZILIAN NAVY TO HAVE FLOATING DRYDOCK

The Brazilian government has placed an order with an English shipbuilding firm for a floating dock to be used in connection with the two big "Dreadnoughts" now being built for her in that country. The dock is to be one of the largest, if not the largest of its kind, in the world, and will have a lifting capacity of 22,000 tons. It is to be constructed in 11 months, at a cost of $913,500.

It is said there is only enough broomcorn to furnish one broom to each housewife in America this year.

MEASURING HEIGHT OF AEROPLANE FLIGHTS

The small captive balloon, the giant leveling rod rising high in the air, and the man with the transit are means adopted at aviation meets to determine the height reached by the contesting aeroplanes. The photograph was taken at the moment Rougier was passing the indicator during aviation week at Brescia, Italy. England's first permanent aviation field has a complete system of height-measuring devices, also.



The Aviation Field at Brescia, Italy

Head of Sunnyside Canal—Appearance of Completed Section

CONCRETE IN MODERN IRRIGATION

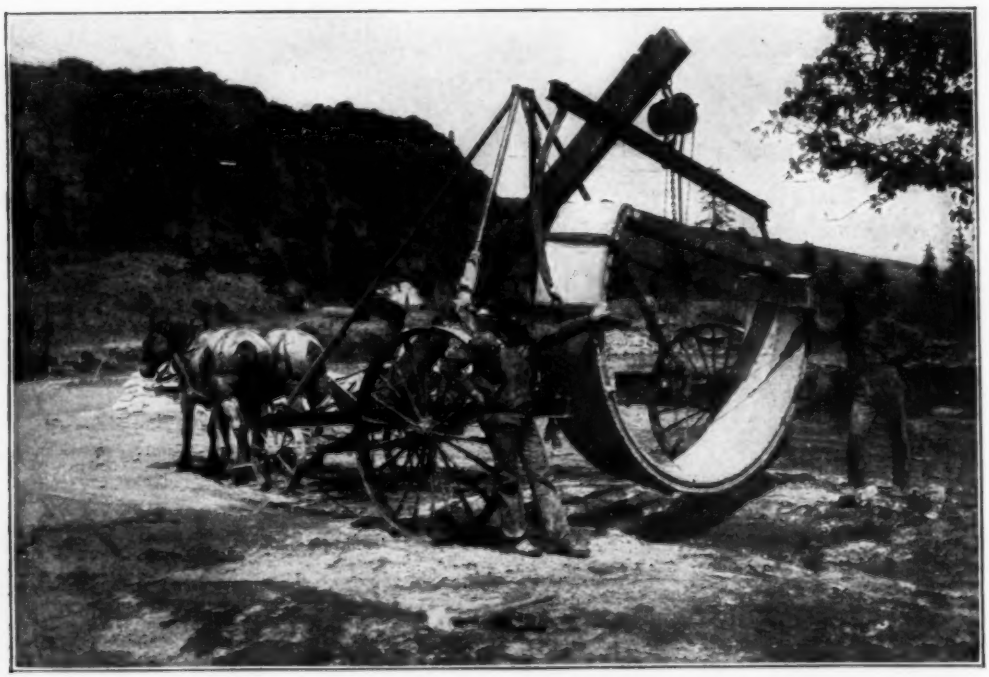
By W. T. Prosser

Building a modern irrigation canal is a far different task from opening the primitive irrigation ditch that was the forerunner of the vast reclamation projects now under construction by the government in the semi-arid sections of the west. Probably no better example of this can be shown than that of the Tieton irrigation canal in the central part of the state of Washington.

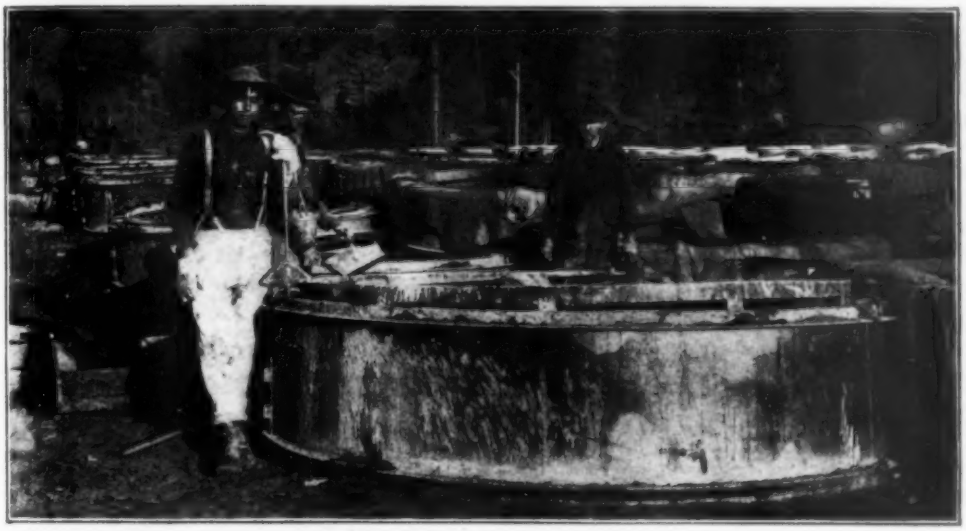
This canal, which will be completed in the near future, will spread water upon 30,000 acres of present sagebrush land, with ultimately a much more extensive scope. When it reaches its final completion the amount of expenditure will be close to $3,000,000.

Concrete Lining Drying in the Sun

Along several miles of this canal the engineers found the conveying of water against the face of precipitous hillsides a difficult problem. Discarding all ordinary flumework, they devised plans for the building of a solid concrete canal. Huge metal forms were



View of Canal from Interior—Transferring Concrete Sections into Position



Molds in Which Sections Were Made

made and transported to the vicinity, a feature of the work most difficult, as the canal is miles from rail transportation in the upper reaches of the Yakima valley. The transportation of the necessary cement was also costly.

In the level portion of the valley these molds were put in place, and the concrete sections were made. Dried by the hot suns of summer, they were then lifted by derricks, transported by horse-drawn trucks, and placed in position by various engineering contrivances. Cemented together, they made a solid flume, open at the top, stretching for miles along the hillsides.

The illustrations give an excellent idea of how the work was carried out. They show rows upon rows of reinforced concrete lining for the canal, drying in the Tieton valley; the method of placing the concrete around the steel forms; transferring the section into position; a view from the interior of the canal; its appearance completed, and the source of its water supply.

The water rushing down the canal gains such headway that abundant opportunity is offered for the use of waterpower in small electric plants for illuminating the canal buildings and furnishing power. The water supply is also so pure that, conveyed in this sanitary canal, it can be used for drinking and domestic purposes, a feature that but few irrigation projects can boast of.

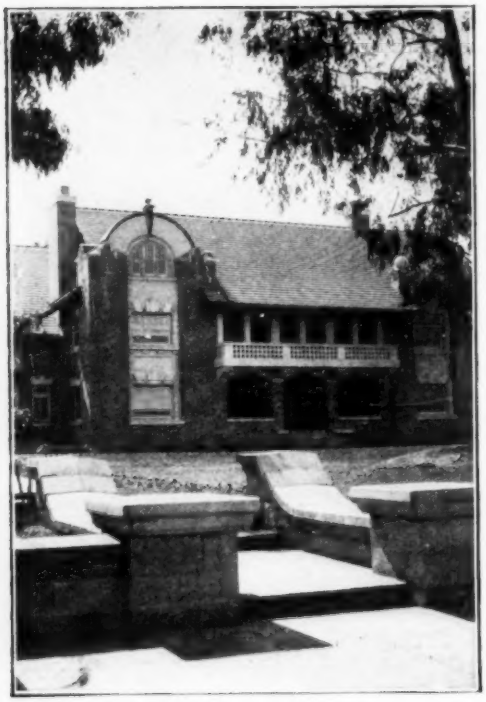
MONKEY-EATING EAGLES

One of the most curious birds of the Philippines is the monkey-eating eagle, which, in spite of its great size, has not long been known to science. Resembling the great harpy eagles, it differs therefrom, and from all other eagles, in the great size of the beak, which is curiously flattened from side to side. It is a forest eagle, and, as its name implies, feeds largely on monkeys.

The zoölogical gardens of London, according to "Knowledge," London, now has the first monkey-eating eagle ever seen alive in Europe.

NATURAL COKE NEAR ANTWERP

Coal of a cokey quality has been found by boring at a depth of 2,000 ft. in the vicinity of Antwerp, in the Campine district, Belgium. As the Belgian coal district is being worked out, this discovery is said to be of the greatest importance, especially as the new field is claimed to be immense.



Tile House in Los Angeles

HOUSE BUILT OF TILE

In order to demonstrate the desirability of his product for the highest class building purposes, a Los Angeles manufacturer of tiles has used this material almost exclusively in the construction of his home. Both the exterior and interior are constructed of the fireproof baked clay.

As the illustration shows, the monotony of the wall surfaces is broken by an arrangement of blocks of various shapes and sizes, each different size and shape being of slightly different shade of terra cotta. The balcony and pillars, the trimmings, and the two large decorative surfaces of the façade are white tile, forming a pleasing contrast to the duller and warmer tones of the walls. The roof is of olive green tiles.

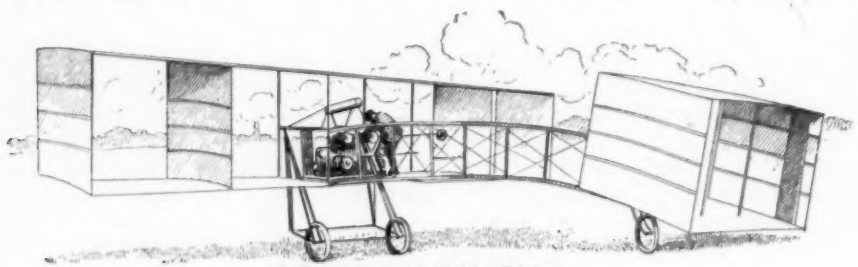
In carrying out the scheme the grounds are inclosed by a terra cotta wall, similar to those which uphold the terraces of the garden. The outbuildings are also constructed of tiles, and the pergola has columns composed of white, glazed tile.

THE NEW VOISIN BIPLANE

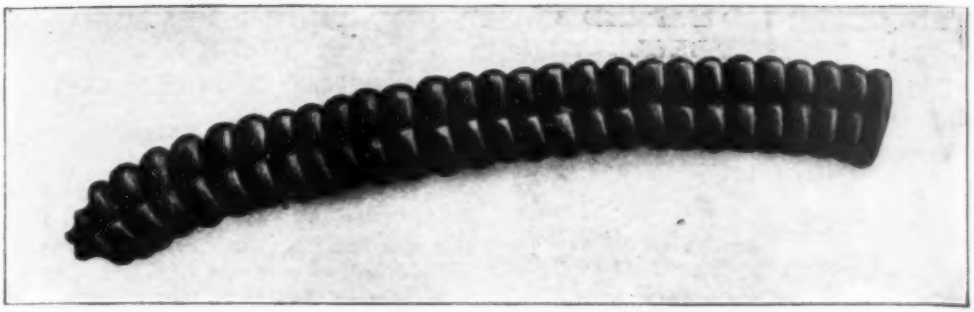
The new type of biplane produced by the Voisin aeroplane interests in France is a combination of the old machine with some of the features developed in the monoplane type. The first change is the removal of the front elevation rudder and the moving of the motor from the rear of the lower plane to its forward edge. The removal of the elevated rudder from the front necessitates a tail, which, as in the monoplane type of machine, is both elevation and lateral rudder. But unlike such rudders on the monoplanes, the cell is devoid of the pivoting vertical plane which fulfills the functions of lateral rudder, and is made to swing to left and right or up and down.

The propeller is mounted in front and pulls the biplane forward, instead of pushing it, as in the old type, and the removal of the front elevation rudder will, it is believed, considerably reduce head resistance and consequently give greater speed.

The arrangement is the first attempt to combine in one machine the best features developed by experiments with the monoplane and biplane types.



A Reconstructed Voisin Biplane



Rattles of Huge Snake

RATTLES OF 9-FT. SNAKE

The rattles in this illustration were taken from a 9-ft. diamond back rattlesnake, killed in a camp near Blue Lake, Miss., by W. J. Wood, of Aurora, Ind. It is probably the largest rattler of this species ever killed, and had 27 rattles and a button. It was killed last July with a shot gun, five shots being required.

THE USES OF TUNGSTEN ORE

Since the discovery of tungsten ore as a metal for the making of a filament for electric lamps, and the great saving in current that has resulted, the general public has lost sight of the fact that the ore is used for other purposes. It is used in the production of tungsten steel, and for the production of the tungstates which are employed in fixing the colors in dyeing, in giving weight to silk goods, and in rendering cotton goods fire-proof.

The ore has recently been discovered in several parts of Canada.

FRISCO "FISHERMEN'S WHARF"

The illustration shows the countless fishing nets that are placed to dry on the famous "Fishermen's Wharf" on North Beach, San Francisco. Hundreds of fishermen may be seen there daily drying and mending their nets between catches. The fish caught in the bay include 40 edible varieties.

Great Wharf Loaded Down with Nets

ANCIENT ROAD MARKED BY ANCIENT BELL

This ancient bell, which called worshipers to one of the old missions of

Historic Bell Landmark

California as far back, probably, as 1776, is now part of a bell-crowned sign post in front of the Mission Dolores in Dolores street, San Francisco, to mark the line which was traversed in the early days by the Franciscan padres.

The ceremony attending the planting of the post was begun with the ringing of the Mission Dolores bells, for the first time since Easter, 1908, and was ended by the blessing of the landmark and the christening of the bell as "St. Francis" by Father Maximilian Neuman.

Several such historic landmarks have recently been erected in different parts of California.

The word "larboard" has been dropped by the U. S. navy.

SEASICKNESS IN CAPTIVE BALLOON

Stranded high in the air in a captive balloon during a wind storm, five Californians, two of whom were women, experienced two hours of seasickness and fright of a nature hitherto accredited to the sea only. The balloon was one used at Sacramento, Cal., to give people an opportunity of ascending to a height of 1,200 ft. at the end of a cable. The regular trip covered a period of from 15 to 20 minutes, but the one in question was prolonged the excruciable two hours by reason of a wind storm so wild that the gasoline engine used to haul the balloon down was powerless to perform its mission. In the meantime the balloon whirled, dived and swayed in such a violent manner that its passengers became too deathly seasick to even sit up in the basket, let alone stand up. When they at last reached earth again all were bordering on hysteria, as were some of the spectators on terra firma.

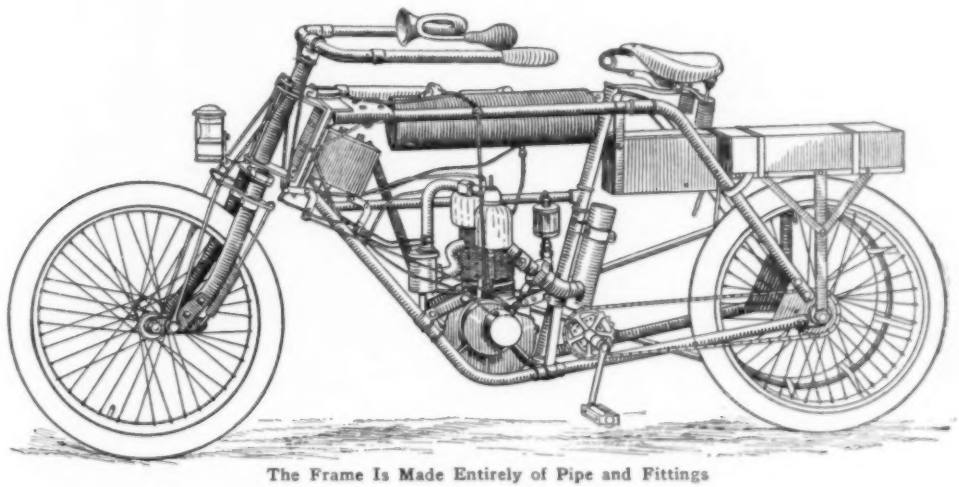
Courtesy Sketch

The Grand Stand of the Future

SHOP NOTES

Home-Made Motorcycle

The frame of this motorcycle is double throughout and made from ¾- and 1-in. gas pipe and pipe fittings. A piece of round iron was inserted in the pipes at each bend to make sure of a rigid frame. No threads were cut on the pipe and the tees used for the cross ties were reamed out, slipped over the pipes, and fastened with a pin.



The Frame Is Made Entirely of Pipe and Fittings

The construction of the forks make them very strong and springs were attached as shown. The wheels and engine were taken from an old and very light runabout. The belt wheel attached to the rear wheel is made from band iron and attached with lugs to the rim. This belt wheel is peened with a hammer in the center to make the crown. A double-ply 2-in. flat leather belt is used to drive the machine. The rear wheel is fitted with a ratchet sprocket, so the engine may be started by peddling. The complete motorcycle weighs 310 lb., has a 70-in. wheel base, 26-in. wheels and a 4-hp. engine.—Contributed by J. O. Turner, Franklin, Ky.

Removing Scale from Water Jackets

Scale usually may be removed from within the water jacket by means of a 20 per cent solution of muriatic acid, says the Nautical Gazette. The jacket is filled with this solution and allowed to remain 3 or 4 hours to dissolve the scale, which may then be blown out. Care must be taken to avoid burns from the acid. The jacket must be carefully washed out afterward with clear water.

A Fire Kindler

Put about a gallon measure full of sawdust that has been well saturated with kerosene into a deep tray. Add enough melted rosin to stiffen the entire amount when it is cold. When cold, this mixture can be cut into squares and put away until ready for use. Put one square of the kindler into the fireplace of a stove and place the fuel on top. A hot fire will be produced a short time after the lighting.

A Fountain Soldering Iron

A fountain soldering iron may be made by drilling an ⅛-in. hole to one side of the tip, straight back into the iron and connecting the same with a

Solder Receptacle in the Copper

¼- or ⅜-in. hole, bored from the top of the iron as near the middle as possible. Solder may be melted and poured into the well from the top, or, better still, use the right size of stick solder and a length may be added while the iron is hot and being used. The iron should be held in a nearly horizontal position, with the point directed slightly downward, the hole, of course, being on the upper side. Capillary attraction will prevent the solder running out of the hole. In use, the solder will flow freely, but may be arrested at any moment by tilting the point upward.

Another method of making the iron is shown in the illustration. The apparatus is all of the simplest construction and can be readily made of sheet iron and wire. The small hole B supplies the melted solder to the point of the iron. The large hole A is the solder receptacle. A valve constructed from a wire, CC, controls the flow of melted solder through the opening B. The valve rod keeps the hole closed by pressure from the spring E, which is placed under the thumb catch, D. A slight pressure of the thumb on D will release the valve wire and allow the melted solder to flow out on the point of the soldering-iron. Any solder can be used with this kind of an iron, as it will melt and run into the well when the iron is hot.—Contributed by C. W. Nieman, New York City.

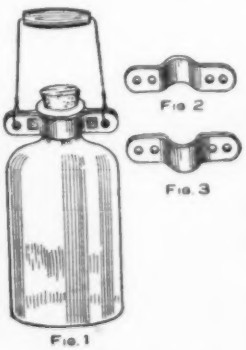
Remove the nozzle from the hose when washing automobile bodies. The water coming through a nozzle will have pressure enough to cause the grit to scratch the varnish.

Rubber Does Not Melt

So many persons have the impression that rubber can be melted. Rubber cannot be melted by heat, yet it can be put into a more or less liquid form by other means. Pure gum rubber will melt easily at 300 deg. F., but commercial rubber has been vulcanized and will not melt. To "devulcanize" rubber is to boil it with an 8-per cent. caustic soda solution; then it is washed, dried and treated with carbon bisulphide or benzine until it is dissolved. The solvent is distilled off to obtain the rubber, but the stuff thus obtained is of small value and has very little strength. To make rubber cement, pure gum rubber must be used. It is dissolved in cold naphtha and a little powdered chalk is usually added. The sulphur added to vulcanize rubber spoils it for melting or other purposes for which pure gum rubber only will answer.

Handle for Carrying a Large Bottle

The water taken from a certain deep well proved to contain certain medicinal properties and the nearby inhabitants would carry the water to their homes in large bottles. As a large bottle is not easily carried without a handle, one person in that neighborhood devised a homemade handle as illustrated in the accompanying sketch. Two pieces were cut from sheet brass, each ¾ in. wide and 6 in. long with the ends rounded off with a file. A ⅛-in. hole was drilled ⅜ in. from the ends of both pieces and another ⅛-in. hole drilled 1¼ in. from each end; this will make four holes in each piece. The pieces are then shaped around the neck of the bottle making a close fit and riveted together through the two in-

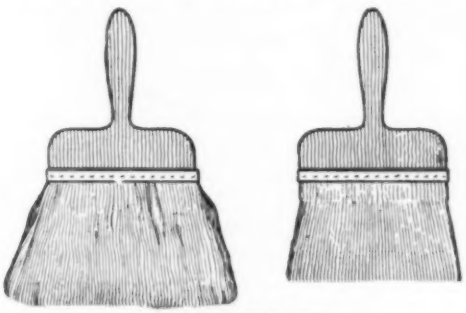


side holes; the outer holes are used for the handles.

Bore a small hole through the center of a 3-in. piece of broom handle and put a piece of wire through, bend it at right angles on both ends of the wood and form a loop in each hole of the brass strips.—Contributed by Oscar M. Sherir, Jasper, Alabama.

Making Over an Old Paint Brush

When a brush is used in varnish and thick paints the mixture usually sticks to the outer hairs and seldom, if ever, reaches the center part. If the brush is left in the bucket and the paint dries, it will produce a hard crust on the outside. A great many painters will throw such a brush away. There will



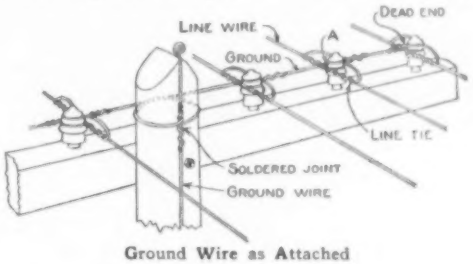
Paint Brush Made Over

be no need of doing this if you take a sharp knife and cut around the top part of the hairs, cutting away the outside part with the dried paint and leaving nothing but the unused hairs remaining. This will make a smaller brush, but it will be practically a new one. The first illustration shows the ordinary brush and the second, one that has been cut down.—Contributed by John Bostie, Kansas City, Mo.

A Home-Made Line Lightning Arrester

A very efficient, as well as inexpensive, lightning arrester that will furnish auxiliary protection for the pole line and instruments is shown in the accompanying illustration. A correspondent of Telephony has used this plan for lightning protection for over two years and it has given practically no trouble from grounded lines.

The insulators should be of the double-groove type, with the line tied

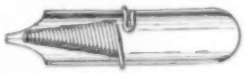


Ground Wire as Attached

in the bottom groove, and the tie ends left long enough to reach within about ¼ to ⅛ in. of the ground wire. The latter is run from the pole to the end of the arm, and tied in the top grooves, with ties cut off close as at A in the sketch, and staggered on the glass to take up the slack after the dead ending. They are placed in this position so that the line wire may not fall upon the ground in the case of a broken insulator, tie, etc. By having the line ties project to the ground wire, instead of the opposite way, they are protected from being cut in two by the lightning discharge, and also prevent water from standing between the line and the ground. The accompanying sketch makes the wiring clear and shows how the ground wire is attached to the ground wire already on the pole.

Fountain for a Common Steel Pen

The accompanying sketch shows a little device for holding a quantity of ink in an ordinary steel pen. This device consists of a small coil of wire made conical and with a loop to pass around the pen for holding it in position. The coil of wire will hold enough fluid to write at considerable length without dipping the pen. —Contributed by Chester Purdy, Ghent, Ohio.



Apply zinc white paint rather thick and spread out under the brush.

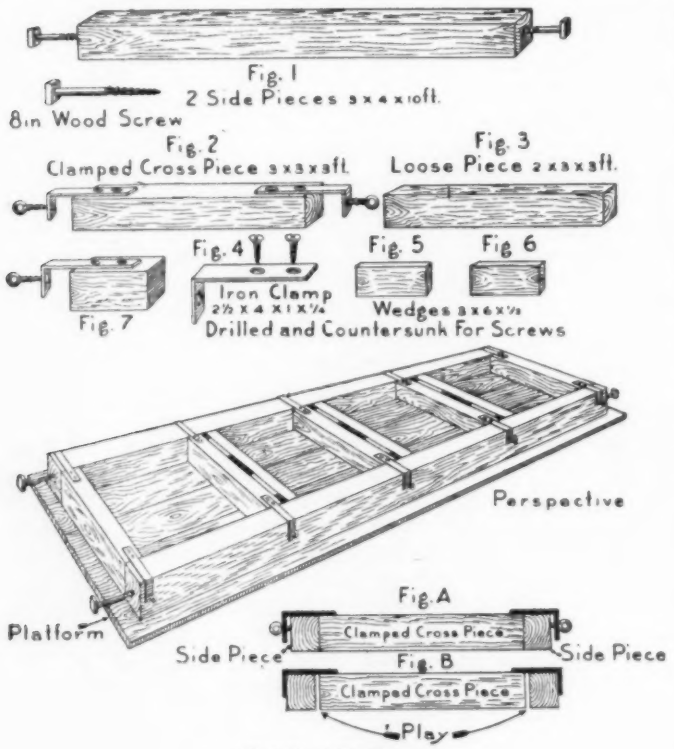
Origin of Standard Railroad Gage in United States

The 4-ft. 8½-in. railroad gage, called "standard gage" in the United States, came originally from horse-operated tram roads in England. One of the earliest of these to use iron rails was built in 1776 for the Duke of Norfolk's colliery near Sheffield. The rails were laid for what was intended to be a 5-ft. gage inside to inside of the wheels of the vehicles.

These rails were of cast iron and flanged. The odd dimension of 4 ft. 8½ in. is the result of a change from flanges on the rail to flanges on the wheel. The first locomotive built with the flanges on the wheels was constructed by George Stephenson in 1814. As his engine was only an experiment, he adopted the 4 ft. 8½-in. inside gage so that it would fit the existing tracks, and from that time to this it has been generally adhered to.

Forms for Making Concrete Sidewalk Flagging

The ease with which concrete lends itself to almost every form of construction, enables even the most inexperienced to produce with it articles of practical worth and utility; the commonest being cement blocks.



Details of the Forms

Various forms of home-made moulds are used, their construction depending entirely upon the ingenuity of the block maker. The writer has met with good success in using the adjustable frame described herewith, its construction permitting the frame to be moved almost as soon as the cement sets. This allows more rapidity in the manufacture—most men like to keep on with the work when once they have acquired the swing.

The frame consists of two side pieces 3 in. thick, 4 in. wide and 10 ft. long, fitted at each end with 8-in. wood screws to serve as handles, Fig. 1; three loose pieces, Fig. 3, 2 in. thick, 3 in. wide and 3 ft. long, five dividing or crosspieces, Fig. 2, 3 by 3 in. and 3 ft. long, fitted at each end with L-shaped iron clamps, Fig. 4. These clamps should be ¼-in. wrought iron, 1 in. wide, 4 in. long on top, with a right-angled bend, 2½ in. long, at one end and drilled with two countersunk holes on top and one hole for a screw eye in the angle end. Screw the clamps on the ends of the crosspieces so as to allow some play between the inner faces of the clamps and the outer edges of the side pieces. The purpose of this is to permit the side pieces being moved a trifle away from two sides of the completed blocks. This is shown in Figs.

A and B. Two or more wedges, Figs. 5 and 6, ½ by 3 by 6 in., are placed between the loose crosspieces and dividing pieces to accomplish the same purpose for the other two sides of the completed blocks.

The proportions of this frame will give four blocks 3 in. thick, 2 ft. wide and 3 ft. long. It can be adjusted to make a longer or smaller number of blocks by dispensing with or adding more dividing and loose pieces. Yellow pine was used for the side and dividing pieces and hemlock for the loose pieces. For strict accuracy, the frame would have to be 9 ft. 10½ in. to mould four blocks in proportions given, but this discrepancy is easily overcome by setting the end crosspieces ¾ in. in from each end.

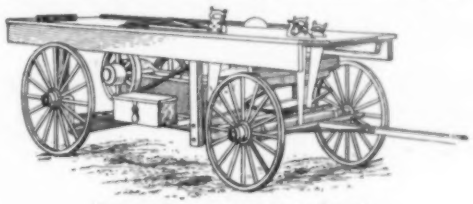
In operation the end pieces are placed in position, screw eyes screwed through the holes in the clamps and into the side pieces, crosspieces inserted and clamped, the loose pieces placed against them and wedges inserted between. The lining of newspapers is now placed on the bottom and against the four sides of each block space, concrete is poured in, rammed and the top coating poured on and planed off with a straightedge when sufficiently set.

The frame is removed by unscrewing and withdrawing the end pieces; unscrew the crosspieces and pull the side pieces outward as shown in A and B. Withdraw the wedges, draw away and remove the loose pieces, do likewise with the clamped crosspieces and finally take away the side pieces.

With a number of platforms, a surprisingly large number of blocks can be turned out in a short time, and the work can be kept going continuously with the one frame.—Contributed by James M. Kane, Doylestown, Pa.

A Carpenter's Workbench on Wheels

The accompanying sketch shows how I made a handy workbench on wheels, which can be drawn by a horse or hitched on behind another vehicle and taken out on a job of work. A small gasoline engine hung on supports beneath the bench runs a circular saw. A place is provided for all tools

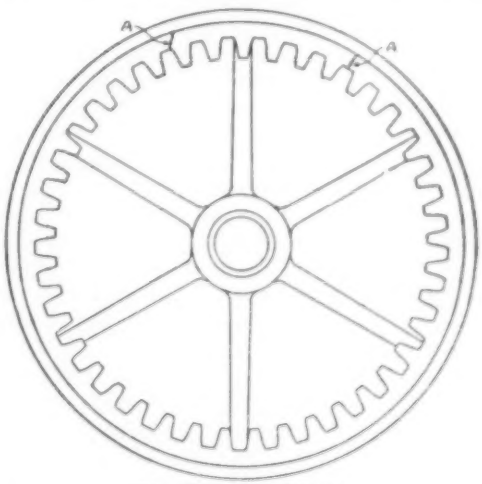


Power Saw Attached to Bench

necessary to be used on any one job. While this is something new and only a saw propelled by the engine, other workmen may be able to add to this device something more than an ordinary power-driven saw.—Contributed by James M. Stockman, Milton Junction, Wis.

A Quick Repair for a Broken Annular Gearwheel

An annular gearwheel, used to drive a mowing machine, was broken at the points A A, as shown in the accompanying sketch. As it was during the busy season and no repairs being at hand, a blacksmith forged a ring of ⅜-in. strap iron and put it on the wheel hot. When the metal cooled it drew



Rim Shrunk on Wheel

the breaks together and the wheel was to all practical purposes as good as new.—Contributed by P. Arthur Tanner, Carson, Iowa.

Flat and Adjustable Step for a Ladder

House painting is very easily done by painters having their own scaffolds, but a person desiring to do his own

The Step on the Ladder

work will have only a ladder to take the place of a scaffold. To paint and stand on the rungs of a ladder all day will tire one's feet. As the writer had to do some painting and a ladder was the only thing obtainable to climb upon, a flat detachable step was made to put upon the rungs of the ladder to stand on the same as a scaffold. The step can be adjusted to any part of the ladder for the painter to stand upon and paint a surface within easy reach. Two irons were bent V-shaped as illustrated, each end having a half circle to fit over the rungs of the ladder. Two holes were drilled in the top angle in which to put bolts for fastening the flat step. The step can be quickly changed from one position to another. A person will feel as safe on the step as if he were on a staging.—Contributed by John Blake, Franklin, Mass.

Home-Made Vacuum Cleaner

This cleaner consists of a bellows formed by the pieces marked F in the sketch and some flexible material such as leather, leatheroid or any material that does not allow the air to pass through. Handles, E, are attached to the sides F with screws or nails. The mouthpiece, C, is made from a piece of wood 2 by 3 by 5 in. with a ¾-in. hole, B, bored through and the piece dressed down as shown. An opening is made into the hole B with a saw cut, A, and both ends covered with small pieces of wood, N, glued to the mouthpiece. The small tube B is a piece of bamboo, the ends of which are fitted and glued into the mouthpiece C and the block T. The sides F are attached to the block T by means of leather hinges, S, which are glued and well tacked to both pieces. A piece of wood, M, is made the same shape as the sides F and fastened in the center of the bellows to keep them from collapsing.

A round piece of wood, G, ¾ in. thick with a small groove cut in its edge, is glued to one of the sides F and a 2-in. hole bored through both pieces. Flap valves, O and J, made from soft leather glued to thin pieces of wood, are hinged to close over the openings as shown. These valves are held shut by light steel springs. A muslin bag,

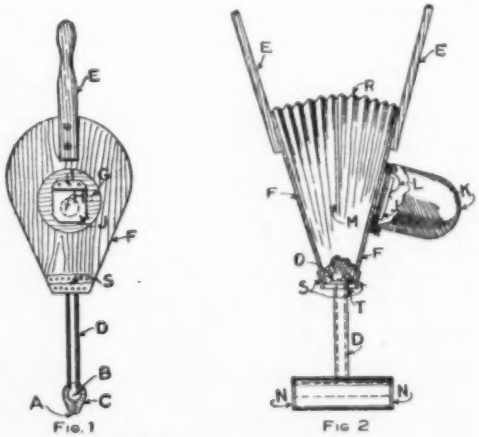


Fig. 1 Fig 2

Hand-Operated Suction Cleaner

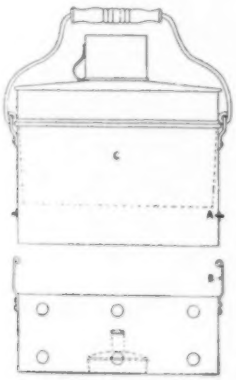
K, is made large enough to fit over the round block G to which it is fastened

by tying into the groove with a piece of twine.

The action is as follows: Grasp the handles and force them apart; this draws the air and dirt through the slot A and when the handles are pushed together the air and dirt contained in the bellows are forced through the valve J into the muslin bag where the dirt is retained and the air liberated through the texture of the cloth. When the bag becomes filled with dirt, it can be easily removed and cleaned.—Contributed by R. H. Brockman, New York City.

Heating Attachment for Dinner Pails

Some years ago I carried my dinner pail to work and as this work was out in the open I had to eat a cold lunch. I finally had a tinsmith make for me an attachment for the bottom of my pail in which to carry a small alcohol lamp. Common rivets, A, were soldered on the sides of the pail to receive the loops, B, of the attachment. The alcohol lamp was made from an old shoe-blacking box with a small piece of tube soldered in for the wick. A small bottle of alcohol, costing 5 cents, would heat my dinners for six days.



When dinner time came I would pour into the lamp a little of the alcohol and light the wick and put the attachment in place. Inside of 5 minutes my tea would be boiling hot and if left for about 15 minutes the whole contents in the upper compartment would be nice and warm.—Contributed by J. E. Noble, Toronto, Can.

Place a tin sleeve in the neck of an ordinary bottle, put in a wick of twisted cotton and fill with kerosene to make a practical and cheap torch.

A One-Piece Ventilator

A simple design of a one-piece ventilator or chimney top is shown in the accompanying sketch. Figure 1 shows a

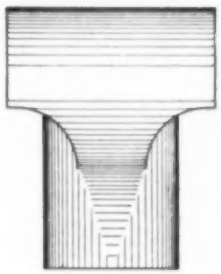


Fig 1

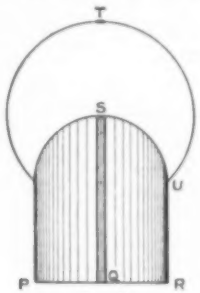


Fig 2

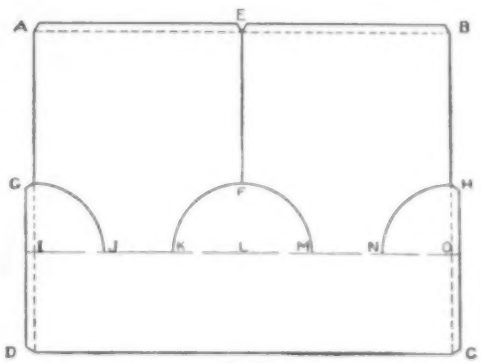


Fig 3
Laying Out the Metal

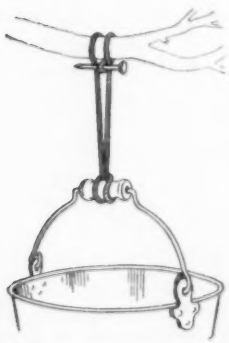
side view and Fig. 2 an end view, while Fig. 3 shows the size and manner of cutting the metal which when formed up makes a complete ventilator.

In laying out the metal, first draw line D C as shown in Fig. 3, making its length equal to the circumference of the base, the diameter of which is shown by P R in Fig. 2. Next draw the line I O. The distance from the base up to this line (I D) can be varied somewhat to suit the size of the ventilator and also the size of the sheet metal at hand. For a ventilator whose base is 6 in. or less in diameter, 4 in. will be sufficient for this height, but if the base is more than 6 in. in diameter, the distance should be increased to 6 or 8 in. Divide the line I O into six equal spaces at I J, J K, K L, etc., then with a compass with the radius set equal to the length of one of these

spaces, draw the arcs G J and N H and the semicircle K F M, using the points I, L and O as centers. The diameter of the top should be about one and one-third times the diameter of the base. The distances I A and O B on lines D A and C B are made equal in length to the distance T U in Fig. 2. Connect A and B and draw E F perpendicular to and bisecting A B and we have the complete layout. Allowance must be made for the seams as shown in the sketch. The edge A E is turned one way and E B the opposite, so when the piece is formed they can be grooved together as shown at T, Fig. 2. The edges G D and H C are treated in the same manner. Before cutting the piece and turning the edges, it is best to run the sheet through a pair of rollers both ways forming it up to about a three-quarter circle each time. This takes all the kinks out of the sheet and makes it form up more smoothly. The heavy lines in the sketch indicate where the sheet is to be cut when ready to be formed.—Contributed by H. M. Sanders, New Haven, Conn.

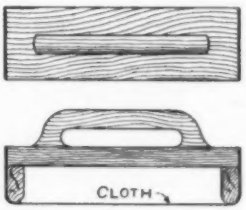
Rope Hanger for a Fruit Picker's Pail

Fruit growers will find the kink illustrated to be all that is desired for holding a pail or a basket to the limb of a tree while they are picking and throwing the fruit into the hanging receptacle. A stout cord or small rope is spliced into a ring or loop and this is given a loop around the bail as shown in the sketch. The other end of the rope is thrown over a limb and passed between the intervening strands and held with a common nail. This rope has the advantage over a hook, as it is easier to make and when made will fit any size limb.



A Home-Made Shoe Polisher

The rag as used by a bootblack in putting a finished gloss on shoes is rather difficult to manipulate when polishing one's own shoes. The device herewith illustrated is designed to overcome this difficulty by keeping the cloth taut and also providing a handle so that it can be used in the same manner as a brush.

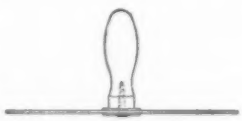


Four blocks of wood are necessary in making the polisher. The main body piece ¾ by 3 by 10 in., the handle ¾ by 1½ by 8 in. and the two end pieces each ¾ by 1½ by 3 in. The end pieces should be rounded on one edge and the whole assembled as shown in the sketch.

The cloth should be stretched tightly between the two end blocks and secured to the ends of the large block with large headed tacks.—Contributed by Ray L. Moyer, St. Louis, Mo.

A Home-Made Plumbers' Force Pump

Sink pipes sometimes become clogged with waste matter and they are very difficult to clean without a plumbers' pump. The little device shown in the accompanying sketch will answer the purpose very well and is made as follows: Secure a round piece of rubber about 6 in. in diameter and 1-16 in. thick and punch a ¼-in. hole in the middle of it. Fasten it to a file handle by means of an ordinary wood screw and a couple of washers as shown. To operate, place the rubber disk over the outlet pipe and fill the sink about half full of water, then raise and lower the handle a few times and the obstruction will be forced out.—Contributed by J. H. Byers, Little Rock, Ark.



How to Make Bent-Wood Sleigh Runners

(Condensed Article from Blacksmith and Wheelwright)

The process for making bent-wood sleigh runners is about the same as for any other bent-wood work, the first thing necessary is to get out the wood for the runners. The blanks should be worked closely to the size with only enough material left on them for "cleaning up" after the bending has been done. The wood selected should be straight-grained and free from knots, shakes and rot. Only good, clean, "live" lumber should be used for bent work. Lumber that has dried on the stump should not be used. Worm-eaten lumber will not bend satisfactorily. The next thing is to make up a form over which the runner is to be bent. If only a few runners are required, bits of board can be nailed to the floor or wall to form the outline of the runner as shown in Fig. 1. If you have a pattern runner, place it upon the floor or wall and mark around the outside with a pencil or scratch awl. If there is no pattern runner to be had, a drawing is made on the floor or wall full size of the shape required for the runner. Nail down several pieces of board, each marked C, Fig. 1, against the drawing or pattern runner, then make other pieces, BBB, which have been cut to the required curves so they will fit as shown. The beauty of the runners will depend upon the location of these pieces for placing in the steamed wood. See that the mould has perfect lines if you want to secure good bent work. If a form is to be built to accommodate quite a number of runners, two stout side frames will be required with crosspieces to take the place of the pieces of board shown in

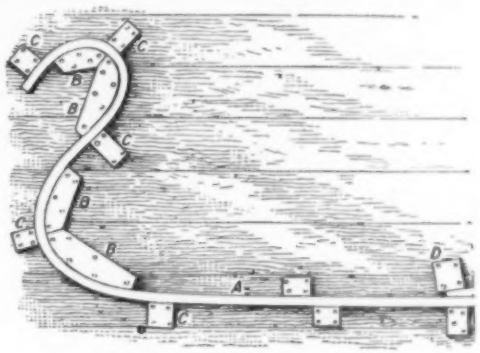


Fig. 1—Blocks Nailed to the Floor

the illustration. The wood is sprung between these blocks or forms after it has been softened by steaming.

A box must be made in which to steam the pieces of wood to be bent, and it must be large enough to take in the required number of pieces for the runners. A good design of a box is shown in Fig. 2. This box is made of 2-in. lumber with the top and bottom boards rabbeted on both edges to receive the two side pieces. Nails or spikes may be used to hold the planks together, but a much better way is to make several clamps, each consisting of two bolts and two pieces of board, and place one every 15 to 24 in. along the length of the box. Both ends of the finished box are squared up and closed with a plank cut to the size, using felt or gunny sack in the joint to make it

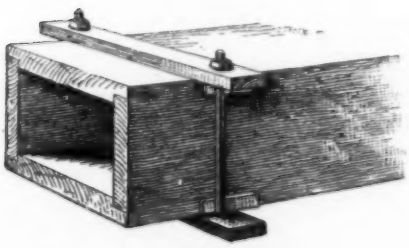


Fig. 2—Steaming Box

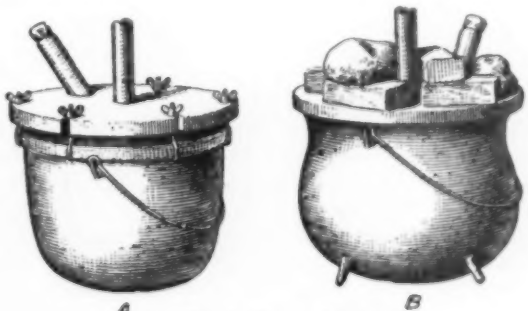


Fig. 3—Steam Generators

as tight as possible. A heavy weight or bar of metal set against each end will be sufficient to hold them in place when steaming the wood.

If there is no boiler in the shop for supplying the steam, a steam generator can be made of a common cast-iron or steel kettle. The kettle may be fitted with a cover clamped down with screws, by shrinking on a band as shown in the sketch, A, Fig. 3; or the cover may be laid on top of the kettle and held in place by a pile of bricks or junk, as shown in the sketch B. The steam pipe is fastened securely into the plank head, which had better be made up of several thicknesses of thin boards with the grain crossed each time and securely bolted together. This will prevent the excessive warping of the cover which is very apt to happen if a single thickness of plank is used. Do not overlook putting in a filling tube. This is shown in both sketches, A and B, Fig. 3, with the end closed by a plug.

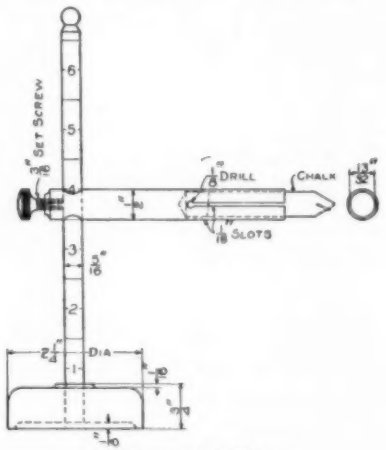
The steam pipe leading to the steam box is shown in both sketches. As there is practically no pressure, iron pipe, sheet iron or tin may be used for the steam pipe. Galvanized rain water conductors can be used and no valves are necessary in making connections.

Bore a hole in the bottom side of one end of the steam box and arrange this end a trifle lower than the other end. The hole will permit the water of condensation to escape. Steam should not escape from the box when a charge of wood is being softened. Steam which escapes from the box in the form of vapor has done no work whatever, and is just so much waste of fuel. In order to give up its heat to the wood the steam must condense and come away from the box as water. Therefore, in steaming a charge of pieces in the box, never crowd the steam kettle so hard that the steam escapes around the head of the box or through any other joints. The steam should be supplied to the box just as fast as it condenses, and no faster. When the pieces are placed in the box they should be so arranged that the steam can find ready access to all sides of each piece.

When taking the steamed pieces from the box do not lose any time in securing them to the forms. Do not take out more than one piece at a time, as it must be bent to the moulds immediately after taking it from the hot steam. The time of steaming will vary with the size of the pieces. Strips ¼-in. thick may be steamed in 15 to 20 minutes, while large pieces may require several hours to become soft enough to bend.

How to Make a Skirt Marker

Make a cast-iron base according to the dimensions given in the accompanying sketch. Drill a 5/16-in. hole in the center and finish the piece all over. The spindle is made out of a

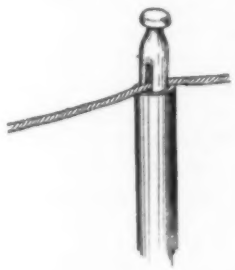


The Assembled Marker

cold rolled steel rod 5/16 in. in diameter and of suitable length. Grooves or marks can be cut around it ½ in. apart to facilitate the setting of the marker to the proper height. They can be numbered as shown, if desired. The crayon or chalk holder is made of ½-in. rod and should be drilled, tapped and slotted as shown in the sketch. The crayon is held in place by the four fingers formed by slotting the end after it is drilled. Either a knurled or a thumb screw can be used in the end for a set screw. The parts can be made of brass or iron instead of cold rolled steel, if desired.—Contributed by Henry Weigand, Buffalo, N. Y.

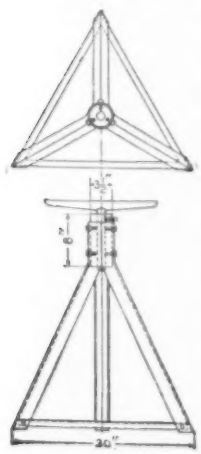
A Clothesline Prop

A serviceable clothesline prop can be made by taking a ¾- or 1-in. pipe from 6 to 8 ft. long, according to the height of the line, and laying the line across the end of the pipe and clamping it with a wood clothespin as shown in the sketch. If the pin is driven down as far as it will go, no wind or jar will cause such a prop to fall. When it becomes necessary to take the prop away the clothespin can be removed and the parts separated.—Contributed by R. M. Woolley, Ft. Casey, Washington.



Floor Stand Tool Rest for Wood-Working Lathes

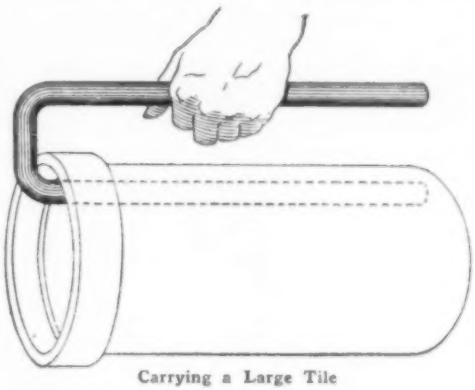
A good design of floor stand for a wood-working lathe is shown in the accompanying sketch. It is very strong and rigid, yet light enough to be moved about with one hand. The casting is 3½ in. in diameter and 8 in. long with a 1¼-in. hole bored through the center. The legs are made of 2 by 2-in. angles shaped at the top to fit the casting to which they are fastened by ½-in. cap screws. The bottom is braced with 1 by 1-in. angles which also serve as a rest for the foot when steadying the stand.—W. W.



A crumpled wire may be quickly straightened by catching one end in a vise and giving the other several hard jerks, using pliers to hold the wire.

Handle for Carrying Tile

A handy device for carrying and laying sewer tile in sizes up to 10 in. in diameter is made from a piece of gas pipe, bent in the shape shown in the illustration. The material required is a piece of gas pipe ¾ in. in diameter and 4½ ft. long. Stick one end of the U-shaped pipe in the bell end of the tile and take hold of the outside part with the hand. A tile can be carried and placed in line with this handle very quickly.—Contributed by Bert La Rue, Girard, Kans.



Carrying a Large Tile

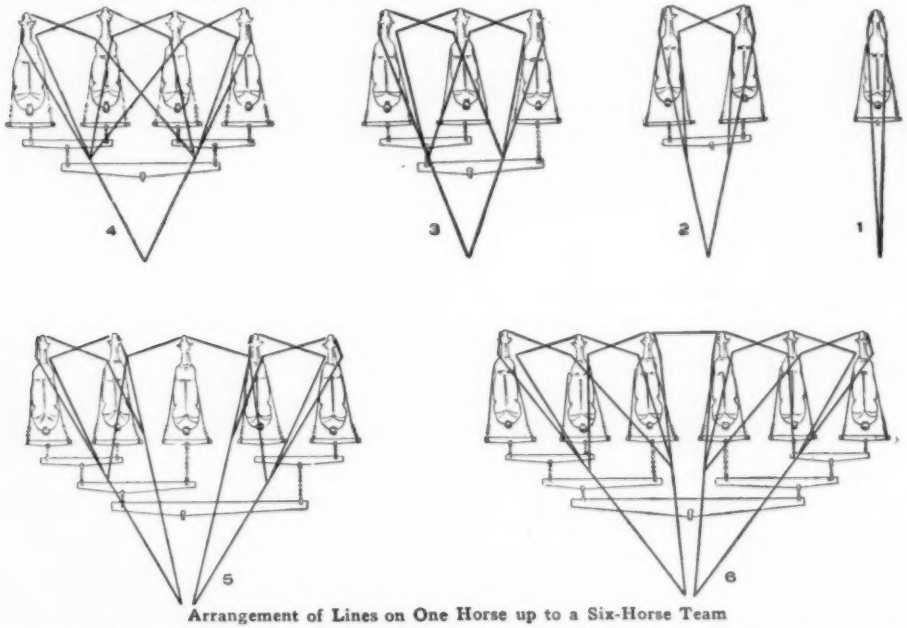
How to Make a Filler for Oil Cups

A small filler for oil cups, which will be found very handy around the engine room, can be made out of an old bicycle pump without much trouble. About all the change that is necessary is to fasten two washers the size of the barrel to the end of the plunger rod as shown in the accompanying sketch. These should be about ¼ in. apart and the space between filled with cotton twine. Then drill a hole in the end of the barrel and solder on a spout. It is used like a syringe in filling oil cups and it can also be used for cleaning out dirty bearings by squirting gasoline into the oil holes.—Contributed by Thomas A. Scott, Walkerton, Can.

Section Through Filler

Arrangement of Lines, Single-Trees and Eveners When Driving Horses

There are differences of opinion regarding the correct arrangement of eveners and single-trees, and in particular the lines or reins. The latter depending much upon the temper of the horse. The writer is acquainted with a farmer who drives several horses abreast without the use of lines or whip, having trained them to go, back, and turn by queer sounding calls.



Arrangement of Lines on One Horse up to a Six-Horse Team

Another farmer drives six horses abreast with a single pair of lines attached to the outside horses, the inside horses being connected with single straps.

The methods of harnessing up from one to six horses abreast are shown in the sketch which have been approved by several farmers that have had several years of experience. The methods shown are for plows, scoops or road-scrapers. When connecting to wagons the only difference is in the design of the last evener, which has a hole in the center for connecting to the pole or tongue instead of the chain hook. Single-trees and eveners for wagons are usually made about one-third heavier than for plows, keeping the same lengths throughout. It will be observed by the arrangement given no horse is able to shirk his duty without being detected. In such a case, the evener will turn in favor of the horse working best, thus enabling the driver to pick out the guilty one.—Contributed by I. G. Bayley, Haddonfield, New Jersey.

Heaters to Prevent Freezing of Sprinkler Systems

Recently an automatic sprinkling system was installed in the shops and car houses of the Chicago & Milwaukee Electric Railroad. The controlling valves for the sprinkler piping system are closely grouped at one end of a car-house bay and it is especially necessary that every precaution be taken to prevent the freezing of these valves, both on account of their first cost and because of maintaining the sprinkler system in working condition. For these reasons the valve group has been enclosed in a tight fitting wooden compartment in which an electric heater

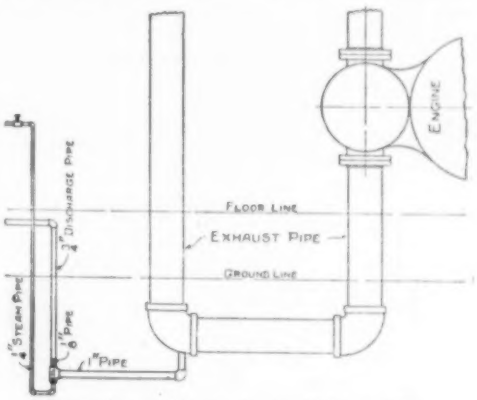
is installed, says Electric Railway Journal. The heater takes its supply of current from the shop circuit and because it is tightly enclosed in the wooden covering with the valves, some means was desired to give a positive indication to the watchman that the heater is at all times in working condition and thus protecting the valves from freezing. To serve this purpose a red bull's-eye from a signal lamp is set in the side of the compartment enclosing the valves and behind this bull's-eye a low candlepower lamp has been placed. Current for operating this lamp is obtained by connecting the leads from the lamp to the heater circuit, using a portion of the heating coils as a shunt for forcing enough current through the lamp to keep it lighted; thus, whenever the watchman passes near the controlling valves for the automatic sprinkler system he can readily note whether or not the lamp behind the bull's-eye is burning, and if so, he may feel assured that the heater within is protecting the expensive valves from frost.

In connection with this sprinkler system there is a pressure tank supported on a high tower in the shop grounds. The intake and discharge pipes to and from this tank are enclosed in a wooden box reaching from the ground to the bottom of the tank. To protect these pipes from freezing, another heater has been installed and similarly a lamp shunted across the heater circuit is installed behind a bull's-eye which, when illuminated, can be seen from the shop.

Removing Muddy Water in an Exhaust Pipe

The accompanying sketch shows the arrangement of a simple steam jet for removing muddy water, etc., from a steam pipe that cannot be drained in the usual way. The sketch shows it connected to the exhaust pipe of an 80-hp. engine, but it can be used in a number of other similar places as well.

Into the side of a 1-in. tee connect a 1-in. suction pipe, about 3 ft. long will do for ordinary purposes, using a nipple and ell at the connection of the pipe to be drained so that the suction will be downward. Bush the lower end of

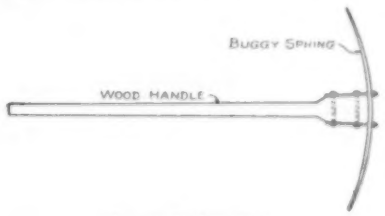


Removing Sediment in an Exhaust Pipe

the tee to ¼-in. for a steam pipe connection. The ¼-in. steam pipe should be reduced in the bushing for a ⅛-in. pipe which should extend through the tee into the discharge pipe about 3 in. A ¾-in. pipe should be used for the discharge.—Contributed by C. L. Payne, Shellman, Ga.

A Light Grubbing Hoe

A light grubbing hoe for use about the garden or truck patch is shown in the accompanying illustration. Secure a leaf out of an old buggy spring, about 18 in. long, and cut the ends off square and grind them sharp. Two short pieces of strap iron with holes for rivets and one end of each upset and threaded for a nut, will be needed to fasten the spring to the handle, which should be



Buggy-Spring Hoe

of wood. Assemble as shown in sketch and you will have a very handy little tool for light work.—Contributed by John A. Wolfgang, McAllisterville, Pa.

Effect of Expansion in a Stack

In examining a large stack of an ingot heating furnace at one of the steel plants, it was discovered that the joint at the point A A shown in the sketch

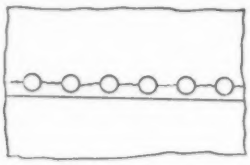


FIG. 1

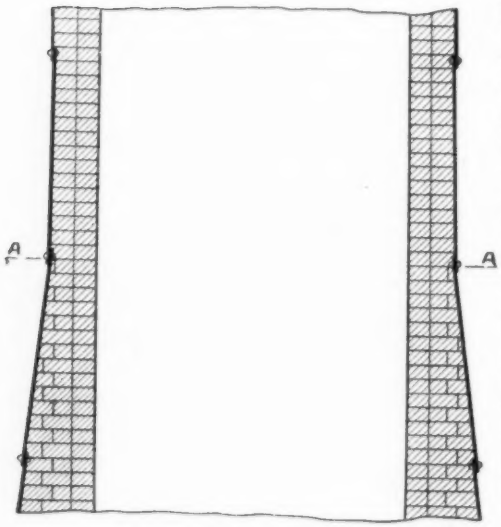


FIG. 2

Break Caused by Expansion

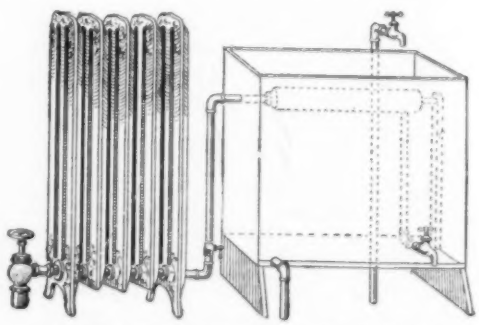
had become separated by one of the rings tearing between the rivet holes as shown in Fig. 1 and that this ring was about 1¼ in. higher than its original position. It is evident from the above that the upper part of the stack above joint A A has risen through a height of 1¼ in., due to the expansion of the brick lining, the latter having also been the cause of the separation of the rings.

It is probable that the stack has been in this condition for quite a long time without having been noticed, and has been continually raising and lowering itself as the brick lining expanded or contracted. It certainly is a remarkable thing that the stack has not fallen over, as there were some very heavy storms in the locality.

The stack will be repaired by securing a band around the separated joint by means of a double row of tap bolts fitting in slotted holes which will allow for the expansion and contraction of the rings.—Contributed by Walter J. Cummer, Bethlehem, Pa.

A Still for Condensing Steam from a Steam Radiator

Distilled water is always required for the dissolution of chemical solids. Water taken from a well, or even rain water, may contain such elements as will act upon the chemical being dissolved in such a way as to render it unfit for the use intended. Classrooms in schools and colleges are always provided with small stills for distilling water to be used in making up solutions in the study of chemistry. The class in one school desired to have plenty of the distilled water on hand at all times and, with the aid of a local plumber, they rigged up an arrangement that would condense the steam taken from a steam radiator to supply a large quantity of distillate. The plumber tapped the steam heater pipe and connected it with a condenser which was fastened in a tank. The condenser consisted of a 2½-in. pipe, reduced at one end for connection with the steam radiator and capped on the other. A hole was drilled on one side



Distilled Water Taken from the Radiator

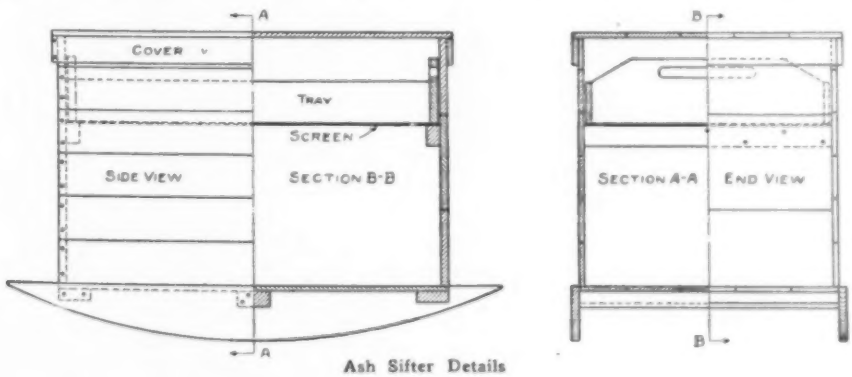
near the capped end and connections made for carrying the distilled water

out through a tap on the outside of the tank.

The tank is of zinc, filled with cold water and kept cold by a small stream of water flowing from a tap. The overflow is carried away through pipes to a sewer.—Contributed by C. D. Luther, Grand Rapids, Mich.

How to Make a Dustless Ash Sifter

Secure a cereal box of your grocer about 2 ft. wide, 2 ft. deep and 3 ft. long, a few inches variation either way from these dimensions will not matter. Go over it carefully and tighten up all the nails, then make a cover, with about 3-in. sides, that will fit closely over the top as shown in the accompanying sketch. Handles can be put on the cover if desired but it is not necessary. Make the tray to fit in loose so it can be taken out easily. The end pieces should be made with hand holes cut in as shown in the end view. The screen is made of ¼-in. wire netting and fastened to the bottom of the tray with double pointed tacks. On the inside of the box nail two strips as shown to hold the tray in place. Now get two 1-in. boards of suitable length and width for the rockers. Lay out the curves with about a 5-ft. radius and cut them to shape with a hatchet and draw-knife. Three cleats should be nailed to the bottom of the box to stiffen it and to support the rockers which should be nailed to them securely.

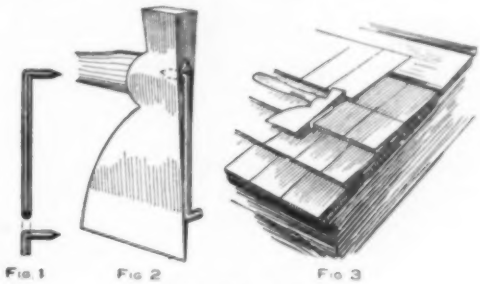


Ash Sifter Details

This sifter will sift two or three scuttles of ashes at one time with very little work, and no dust, if it is properly constructed. The ashes should be cold to get the best results.—Contributed by J. C. Judkins, W. Medford, Mass.

Shingle Gauge for a Hatchet

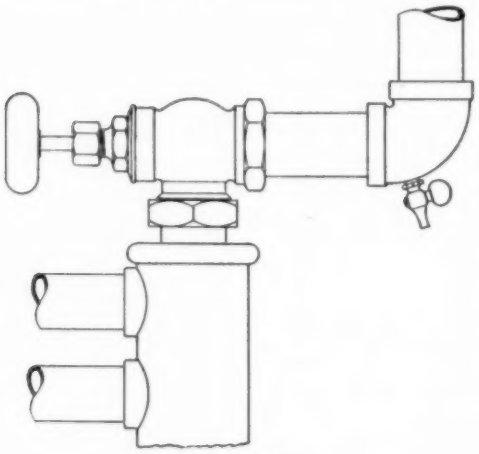
There are many places on a roof where it is not practical to lay shingles to a chalkline or straightedge, which makes it necessary to use some kind of a gauge. Instead of having a special gauge for this work, one can be attached to the shingling hatchet as shown in the accompanying sketch. The gauge consists of a piece of wire bent as in Fig. 1 and attached to the hatchet by driving the sharp end into the end of the wood handle, Fig. 2. A staple is also driven over the wire to keep it from turning. The method of using the gauge is shown in Fig. 3. The length of the wire will depend upon the number of inches the shingle is to be exposed to the weather.—Contributed by H. J. Weiss, Bessemer, Alabama.



Hatchet Shingle Gauge

How Freezing Was Avoided in a Steam Pipe

The accompanying sketch shows how to overcome the annoyance and trouble caused by return steam pipes



Pipe Drain

freezing on account of a leaky valve at the boiler, says the Wood-Worker. This valve seat in one instance became worn and could not be closed tightly and as it was not convenient to close down during the week to make repairs the steam pipe was tapped at the lower elbow and a pet-cock attached and at night when the steam was shut off at the boiler the valve at the coils was also closed and the pet-cock opened, which let all the condensed steam out, instead of into the pipes where it would collect and freeze in the return pipe. This proved to be a very satisfactory arrangement until time could be found to grind the valve at the boiler. This may be of some benefit to others who may not want to let their steam run all night and are troubled with water in the pipes freezing.

How to Find the Candlepower of Any Light

To compare the illuminating powers of any lamp and a candle the following method can be used: Place a small upright rod in front of a screen, as shown in the accompanying sketch. The screen can be made of cardboard fastened on feet to hold it upright on the table. Place the candle so that a shadow is cast by the rod on the screen. Now place the lamp in such a position that another shadow of equal depth or degree of darkness is cast alongside the first. Measure the distance (D_1) from the candle to the screen and the distance (D_2) from the lamp to the screen.

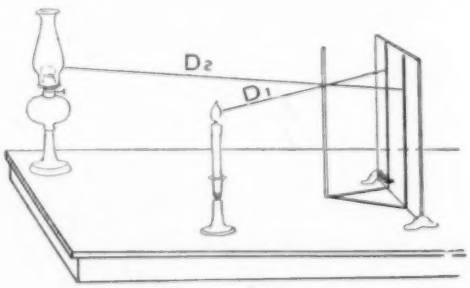
If I_1 and I_2 denote the illuminating powers of the candle and the lamp respectively, I_1 and I_2 will be proportional to the intensities of the illuminations produced by the candle and by the lamp respectively at a unit distance.

When I_1 is the intensity of illumination produced by the candle at a unit distance, $\frac{I_1}{D_1^2}$ = the intensity of illumination at a distance of D_1; and when I_2 is the intensity of the illumination produced by the lamp at a unit distance, $\frac{I_2}{D_2^2}$ = the intensity of the illumination of the lamp at a distance of D_2, but the intensity of the illumination produced by a candle at the distance D_1 equals the intensity of illumination produced by the lamp at a distance D_2. That is

$$\frac{I_1}{D_1^2} = \frac{I_2}{D_2^2} \text{ or } \frac{I_2}{I_1} = \frac{D_2^2}{D_1^2}$$

If the candle is a standard one, the illuminating power of the lamp = $\frac{D_2^2}{D_1^2}$ candlepower.

The rule is: Square the distance of the lamp from the screen and divide



Position of Candle, Lamp and Screen

by the square of the distance of the candle from the screen and the result will be the candlepower of the lamp.

Shaping Pattern Gear Teeth on a Lathe

It is a very slow and difficult task to work out teeth by hand for a large gear pattern and have them all exactly alike and correct. The accompanying sketch shows a device whereby they can be shaped on a lathe, thus making the work much easier and saving considerable time. First work out a tooth to the pitch wanted, making it about twice the length of one tooth. Now cut out a recess the exact length of tooth and drive two brads into the body piece and sharpen the heads as shown in Fig. 1. Next turn up a spindle of a suitable diameter and length and cut out a recess as wide as the tooth is long and deep enough so that when a piece of sandpaper is glued on, it will be flush with the rest of the spindle, as shown in Fig. 2. A tooth is cut out roughly on a circular

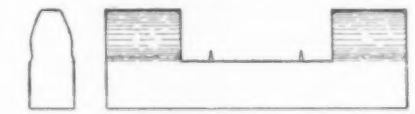


Fig. 1

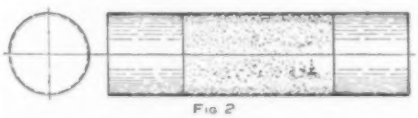


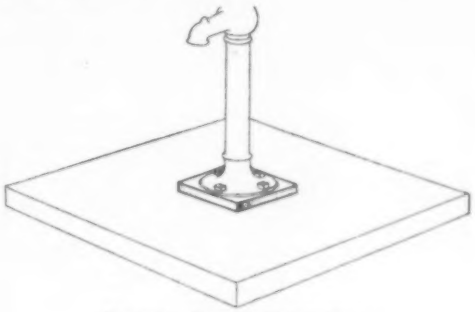
Fig. 2

The Tooth Form and Sandpaper Roll

saw, then inserted in the first piece described, the brads holding it in place. When holding the tooth against the revolving spindle in the lathe, it can be worked out to the desired shape in a very short time and every tooth will be exactly alike.—Contributed by Fred Ambrose, Stevens Point, Wis.

Keeping Waste Water Out of a Well

A good method to prevent waste water from running back into the well or cistern is shown in the accompanying sketch. A cement boss 1 in. thick is put around the pump hole and over the well cover. The boss should be a little larger than the diameter of the foot flange on the pump. This boss can be applied to a flagstone as well as to a cement stone.

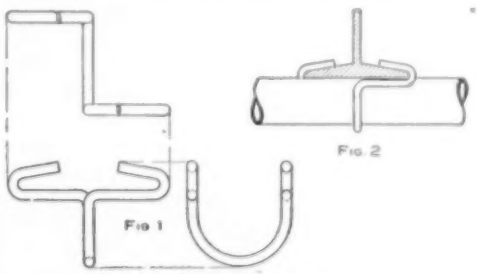


Concrete Around Pump Base

A tin or wooden box can be fitted in the pump hole to act as a core. This is a cheap and good method which can be applied by any one. The boss requires only a shovelful of mortar and a few minutes' time in making.—Contributed by Arch Owen, Youngstown, Ohio.

A Simple Pipe Hanger

There are a great many different devices used for hanging gas or water pipes to the under side of I-beams that support concrete floors, but the one shown in the accompanying sketch will be found to be very simple and easily made and to answer the purpose for which it is intended very well. All that is necessary is to secure some ¼ or ⅜-in. round iron wire and bend it as shown in Fig. 1. To secure it to the I-beam, place it in position, then ham-

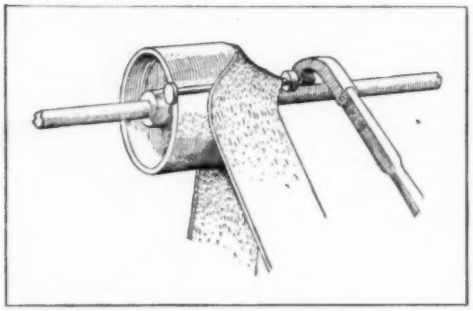


Bent Wire Pipe Hanger

mer the ends until they are tight. Fig. 2 shows an assembled view of the hanger.—Contributed by Vary Mengle, Scranton, Pa.

A Belt Shifter

The belt pole shifter construction, as shown in the illustration, is very popular in Germany, says American Miller.

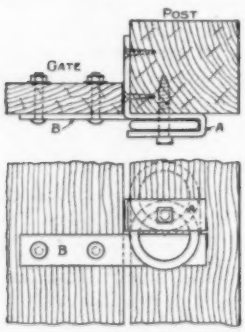


Putting a Belt on a Pulley

The making of this shifter is quite simple and will be readily understood from the sketch without any further description. The general make-up would seem somewhat heavy, but apparently it is perfectly adapted to the purpose intended.

A New Gate Latch

A new style of gate latch which is very simple in construction and neat in appearance is shown in the accompanying sketch. To make it, two pieces of 1-in. strap iron, about 8 in. long, and a ring about 2 in. in diameter are needed. Bend one of the straps as shown at A, one end to fit about the post and the other around the ring. Drill holes in it for the wood screws and the lag screw. The lag screw holds the ring in place and also helps to hold the strap to the post. The lower strap is straight and has two holes drilled in it for bolts which fasten it to the gate. When it is desired to open or close the gate, the ring is raised, as shown by the dotted position in the sketch, so as to allow the lower strap to swing in or out from the gate post. This makes a strong latch and one that does not easily get out of order.—Contributed by Bert La Rue, Girard, Kan.



Sawing Frozen Lumber

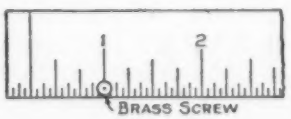
In sawing frozen lumber, the sawdust has a tendency to slip by the throat of the tooth, stick on the lumber and bind the saw which throws it out of true, especially so with an inserted tooth saw. This requires a specially made shank, at least two gauges thicker than the saw plate, when using inserted toothed saws.

When fitting up a new set of teeth, first put in the new points then go all around the saw and make the shanks even with the points, says a correspondent of the Wood-Worker. Side file each tooth to a gauge, and if the bit does not set straight in the plate, take it out and file where the shank bears until it does set straight, then put the saw on the mandrel, run slowly and hold a piece of emery wheel against the teeth until they all strike. Care must be taken to keep from knocking off the corners of the teeth and also have them square. If all of this is done the saw is quite sure to run well, provided the other parts are right.

In cold weather it is quite important to keep the corners of the thick shanks square, having the teeth side dressed to a gauge, with the widest part at the extreme point, and the saw rounded so all the teeth cut alike.

Preserving Wooden Rules

Wooden rules such as are used by carpenters and patternmakers are in time badly marred and worn by the constant pricking of the divider or compass points in setting off dimensions. The accompanying sketch shows how this may be avoided. Drill a small hole through the rule on the 1-in. line and screw in a short brass



A Quickly Made Surface Gauge

A radiator having 50 ft. of surface will

screw which is then filed off flush and smooth with the rule on both sides. Make a small mark with a prick punch in the center of this screw, then one leg of the divider can be set in this center mark while the other is opened to the required dimension.—John Andrews.

A Barrel Shelf

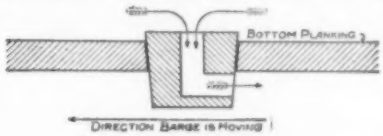
The groceryman receives a large portion of his goods in barrels and the clerk finds it quite a task to make up sugar and rice into packages for the trade. Herewith is illustrated a little device that will greatly assist him when

Shelf Fits Any Barrel

filling paper bags with the product contained in a barrel. The shelf is made of a board having a width that will about cover one-quarter of the barrel rim. Four nails are driven through one end of the board to allow the ends to pass down on each side of the hoop and staves. A brace is attached to the other end so it will rest on one of the lower hoops.—Contributed by Don C. Higbee, S. Omaha, Nebraska.

A Siphon Bilge Pump

The method of draining barges of bilge water by means of a siphon plug in the bottom is shown in the accompanying sketch. This scheme will work equally well on any power-driven craft that has a speed of 4 miles an hour or more. A hole is bored nearly through the plug then another bored at right angles to the first through the side, near the bottom, as shown in

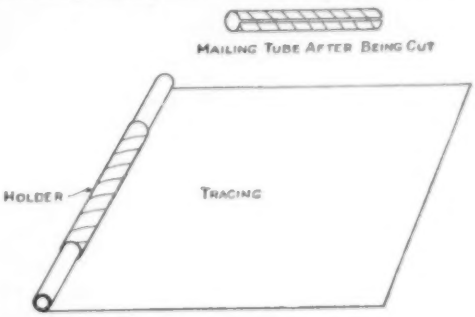


Section Through Pump

sketch. The plug is then placed in the bottom of the barge to be drained with the hole in the side pointing aft, says a correspondent of Motor Boat. When the barge is in motion the hole in the plug is uncorked and the water will be drawn or sucked out.

Tracing Holder

Very often draftsmen experience considerable difficulty in handling a large tracing on a small table top. This can be easily overcome in the following manner: Take an ordinary mailing tube of convenient length and diameter and cut a slit from ⅛ to ¼ in. wide along its entire length and after rolling up the portion of the tracing not needed for immediate use, slip the tube over the roll, leaving the part to be used outside the split. This will prevent the necessity of leaving the tracing hang over the corner of the



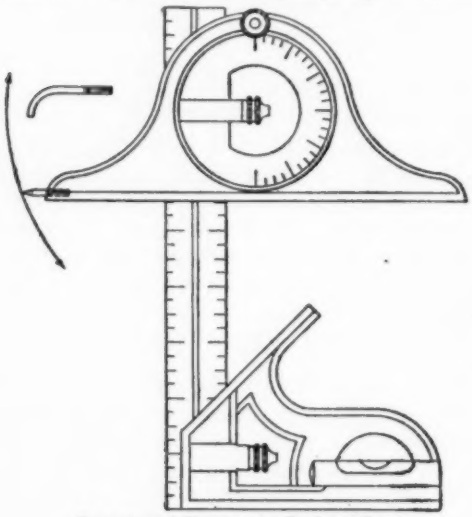
TRACING HOLDER IN USE

table and facilitate shifting it, thereby decreasing the possibility of breaks or creases.—A. J. Willison, Jr., Bramwell, West Virginia.

Do not run an automobile along in the car tracks as this grinds down the edge of the tire.

A Quickly Made Surface Gauge

A surface gauge made from a combination square and protractor head is shown in the accompanying sketch.



Square and Protractor Surface Gauge

Two short pieces of ⅛-in. steel will be required. One piece should be pointed at one end and threaded at the other. The other piece should be bent in the form of a caliper leg as shown in sketch and also threaded at the other end. The protractor head should be tapped ⅛ in. to receive either of the pieces as required. The two adjusting screws on the protractor head come in very handy in setting the points to any required height.—Contributed by T. Gregson, Lachine Locks, Canada.

Pipe Coil Water Heater for a Stove

When making a coil for the fireplace of a stove use a piece of 1-in. lap-welded pipe and in bending be sure that the weld is on the upper side, says the Metal Worker.

It will be well to cut long threads on the ends which extend through the stove so that a lock nut can be used both on the inside and on the outside to make a tight fit and if an asbestos washer is used it will prevent the escape of ashes. The size of the coil will depend on the size of the radiator used. A radiator having 50 ft. of surface will require a heating coil with about 3 ft. surface, in order to take care of the radiator surface exposed in the return and flow pipes. This means a pipe 9 ft. long. If the coil is arranged so that it enters the stove on one side and extends around at the top of the fire chamber so the hot coals lie against it, and then on the opposite side to the point of entrance it rises alongside the door and the remainder of the surface is coiled above the fire and the outlet end is carried up near to the top of the stove before passing out, the heating capacity will be materially improved over exposing the entire coil above the door which might at times be left open to check the fire. This arrangement of the coil in the stove will avoid interference with putting coal on the fire.

If the coil is put in the stove, some method of checking the draft instead of opening the door should be provided even to the extent of making a tee joint in the smokepipe with one end of the tee to be closed with a tight damper or opened as the draft needs to be reduced. After the pipe coil passes out of the stove, the flow main should run up to a point a foot or so below the ceiling where it should be connected into an expansion tank which will hold 3 to 5 gal. This will take care of the expansion of the water on heating and allow the air, which otherwise would accumulate in the pipes, to escape. The flow main could be connected with the tank and the hot water taken from the tank and carried along it with a gradual downward pitch until it connects with the radiator. The return pipe can be run back to the stove either in the ceiling of the basement beneath the floor or along the floor if the location of the radiator will enable this to be done in a manner which will not be unsightly or objectionable. At the low point there should be arranged a cock for emptying the system when necessary. If the return pipe is exposed in the cellar, it should be covered, so as not to give the heating coil in the stove more work to do than it can readily take care of.

AMATEUR MECHANICS

A Library Set in Pyro-Carving

By Helen Westinghouse

The multitude of indifferently executed small articles which followed the introduction of pyrography is beginning to disappear, people are considering the art more seriously and applying it to more dignified uses. Pyro-carving is one of the new methods of decorating furniture which is both beautiful and practical, two qualities which do not always go together.

The library set illustrated consists of a table 30 by 50 in. with two benches, 14 in. wide of the same length. The supports are made of selected white pine, which must be absolutely free from pitch. The pine is soft enough to work easily with the point and stands wear much better than basswood. The tops and braces are made of curly fir, all of the material must be 2-in. lumber, which dresses to about an inch and a half. All surfaces, except the faces of the supports, are given a well-rubbed coat of oil with a little burnt umber, the stain to be applied directly to the wood without a filler.

On the outside of the supports the design is drawn in with pencil, the background is then cut out smoothly with a chisel to the depth of an eighth of an inch, leaving the decoration in relief. It is then burned deeply, the background in straight flat strokes, the outlines having the effect of a sloping, dark edge. The shadows are burned in as deeply as possible and the shading is put in with the flat of the point.

A wax or egg-shell oil varnish finish is most suitable for this set.

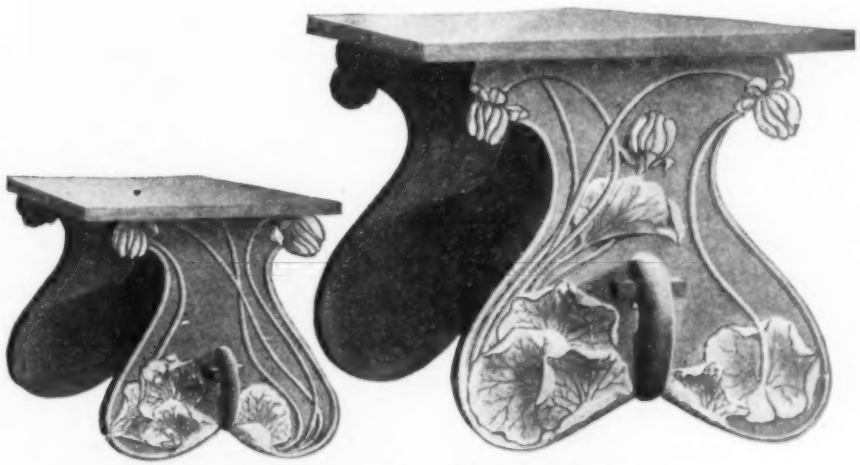


Table and Seat Decorated in Pyro-Carving

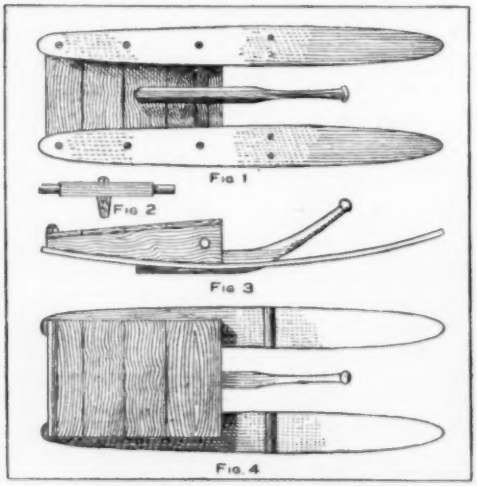
A Phoneidoscope

The phoneidoscope has many and varied forms, but the simplest can be made by bending the forefinger and thumb so as to form a circle and then drawing a soap film across them. This is done similar to blowing soap bubbles.

The angle with the direction of the light may be readily adjusted by turning the wrist, a motion of the elbow alters the distance from the mouth and the tension of the film can be regulated by moving the thumb and forefinger. Singing or speaking at the film when under proper tension will cause beautiful figures to appear, which may be reflected from the film directly on the screen.—Contributed by Robt. E. Bradley, Winchester, Mass.

A Home-Made Yankee Bobsled

A good coasting sled, which I call a Yankee bob, can be made from two hardwood barrel staves, two pieces of



Runners Made of Barrel Staves

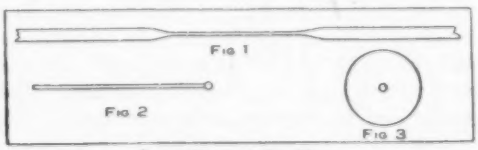
2 by 6-in. pine, a piece of hardwood for the rudder and a few pieces of boards. The 2 by 6-in. pieces should be a little longer than one-third the length of the staves, and each piece cut tapering from the widest part, 6 in., down to 2 in., and then fastened to the staves with large wood screws as shown in Fig. 1. Boards 1 in. thick are nailed on top of the pieces for a seat and to hold the runners together. The boards should be of such a length as to make the runners about 18 in. apart.

A 2-in. shaft of wood, Fig. 2, is turned down to 1 in. on the ends and put through holes that must be bored in the front ends of the 2 by 6-in. pieces. A small pin is put through each end of the shaft to keep it in place. The rudder is a 1½-in. hardwood piece which should be tapered to ½ in. at the bottom and shod with a thin piece of iron. A ½-in. hole is bored through the center of the shaft and a lag screw put through and turned in the rudder piece, making it so the rudder will turn right and left and, also, up and down. Two cleats are nailed to the upper sides of the runners and in the middle lengthways for the person's heels to rest against.

Any child can guide this bob, as all he has to do is to guide the rudder right and left to go in the direction named. If he wants to stop, he pulls up on the handle and the heel of the rudder will dig into the snow, causing too much friction for the sled to go any further.—Contributed by Wm. Algie, Jr., Little Falls, N. Y.

How to Make a Small Microscope

Theoretically a simple microscope can be made as powerful as a compound microscope, but in practice the minute size required by the simple lens to give the highest power makes it almost impossible to be used. However, a lens having a reasonable magnifying power can be made in a few minutes for almost nothing. Take a piece of glass tubing, heat one place in a hot flame, hold one end and pull on the other and draw the heated place down to a fine string as shown in Fig. 1. Take about 3 in. of this fine tube and heat one end which will form a glass bead as shown in Fig. 2. This bead is the lens. When in this form it can be used only in an artificial light coming from one direction, but if you take a piece of card-



Lens Formed by Heat

board and bore a hole in it a little smaller than the bead on the glass tube which is forced into the hole, Fig. 3,

you can use this mounted lens in ordinary daylight. In this case a mirror must be used to reflect the light up through the lens. It is difficult to see anything at first, as the lens must be held very close to the eye, but in practice you will soon learn to see the object as it appears enlarged.

If you soak a little dried grass or hay in water for a few days and look at a drop of this water, germs in various life forms can be seen. The water must be put on the lens. One thing to remember is that the smaller the lens, the greater the magnifying power.—Contributed by Daniel Gray, Decatur, Illinois.

The water in hot water supply pipes will freeze quicker than water that has not been heated. This is because the air, which is a poor conductor of heat, has been driven out by the heat.

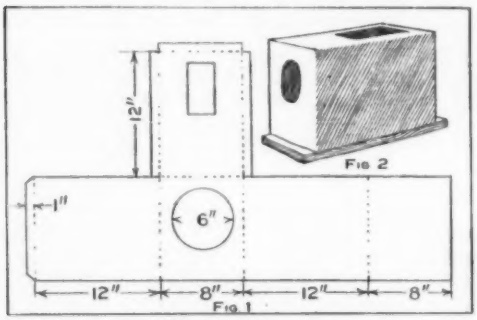
How to Carry Books

Almost all school children carry their books with a strap put around and buckled very tight. This will make dents in the cover where the board overlaps the body of the book. If the strap is left loose, the books are liable to slip out. Place the cover of one book between the cover and fly leaf of its neighbor and the difficulty will be remedied. This will place the books in alternate directions. Books stacked in this manner do not require the strap buckled tight, or, they can be carried without any strap just as well.—Contributed by Thos. De Loof, Grand Rapids, Mich.

BOTTLE PUSHERS.—This is a game in which the competitors push bottles on the ice with hockey sticks. All the bottles must be the same size and make. The persons participating must keep their bottles upright at all times. The bottles are lined up for the start and at the word "go," each person pushes a bottle across the field for a distance that is agreed upon.

A Home-Made Magic Lantern

The essential parts of a magic lantern are a condensing lens to make the beam of light converge upon the slide to illuminate it evenly, a projecting lens



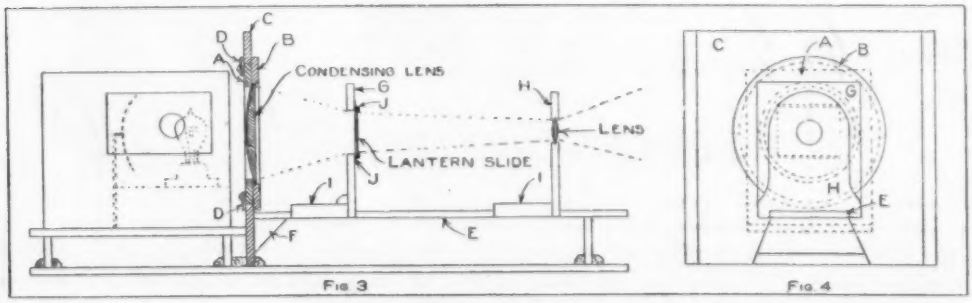
Lantern House

with which to throw an enlarged picture of the illuminated slide upon a screen and some appliances for preserving the proper relation of these parts to each other. The best of materials should be used and the parts put together with care to produce a clear picture on the screen.

The first to make is the lamp house or box to hold the light. Our illustration shows the construction for an electric light, yet the same box may be used for gas or an oil lamp, provided the material is of metal. A tin box having dimensions somewhere near those given in the diagrammatic sketch may be secured from your local grocer, but if such a box is not found, one can be made from a piece of tin cut as shown in Fig. 1. When this metal is bent at right angles on the dotted lines it will form a box as shown in Fig. 2 which is placed on a baseboard, ½ to ¾ in. thick, 8 in. wide, and 14 in. long. This box should be provided with a reflector located just back of the lamp.

Procure a plano-convex or a bi-convex 6-in. lens with a focal length of from 15 to 20 in. and a projecting lens 2 in. in diameter with such a focal length that will give a picture of the required size, or a lens of 12-in. focus enlarging a 3-in. slide to about 6 ft. at a distance of 24 ft.

The woodwork of the lantern should be of ½-in., well seasoned pine, white wood or walnut and the parts fastened together with wood screws, wire brads, or glue, as desired. The board in which to mount the condensing lens is 16 in. wide and 15 in. high, battened on both ends to keep the wood from warping. The board is centered both ways, and, at a point 1 in. above the center, describe a 9-in. circle with a compass and saw the wood out with a scroll or keyhole saw. If a small saw is used, and the work carefully done, the circular piece removed will serve to make the smaller portion of the ring for holding the condensing lens. This ring is made up from two rings, A and B, Fig. 3. The inside and outside diameters of the ring B are ⅜ in. greater than the corresponding diameters of ring A, so when fastened together concentrically an inner rabbet is formed for the reception of the lens and an outer rabbet to fit against the board C in and against which it rotates being held in place by buttons, DD.



Magic Lantern Details

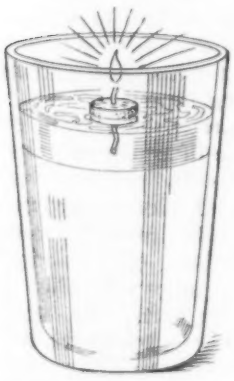
A table, E, about 2 ft. long is fastened to the board C with brackets F and supported at the outer end with a standard. The slide support, G, and the lens slide, H, are constructed to slip easily on the table, E, the strips II serving as guides. Small strips of tin, JJ, are bent as shown and fastened at the top and bottom of the rectangular opening cut in the support G for holding the lantern slides.

All the parts should be joined together snugly and the movable parts made to slide freely and when all is complete and well sandpapered, apply two coats of shellac varnish. Place the lamphouse on the bottom board behind the condensing lens and the lantern is ready for use.

The proper light and focus may be obtained by slipping the movable parts on the board E, and when the right position is found for each, all lantern slides will produce a clear picture on the screen, if the position of the lantern and screen is not changed.—Contributed by Stuart Mason Kerr, St. Paul, Minn.

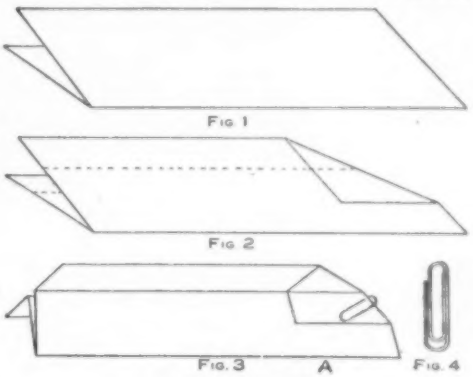
A Quickly Made Lamp

A very simple lamp can be made from materials which are available in practically every household in the following manner: A cheap glass tumbler is partly filled with water and then about ½ in. of safe, light burning oil, placed on the water. Cut a thin strip from an ordinary cork and make a hole in the center to carry a short piece of wick. The wick should be of such a length as to dip into the oil, but not long enough to reach the water. The upper surface of the cork may be protected from the flame with a small piece of tin bent over the edges and a hole punched in the center for the wick. The weight of the tin will force the cork down into the oil. The level of the oil should be such as to make the flame below the top of the tumbler and the light then will not be blown out with draughts. The arrangement is quite safe as, should the glass happen to upset, the water at once extinguishes the flame.—Contributed by G. P. B.



How to Make a Paper Aeroplane

A very interesting and instructive toy aeroplane can be made as shown in the accompanying illustrations. A sheet of paper is first folded, Fig. 1, then the corners on one end are doubled over, Fig. 2, and the whole piece finished up and held together with a paper clip as in Fig. 3. The paper clip to be used should be like the one shown in Fig. 4. If one of these clips is not at hand, form a piece of wire in the same shape, as it will be needed for balancing purposes as well as for holding the paper together. Grasp the aeroplane between the thumb and forefinger at the place marked A in Fig. 3, keeping the paper as level as possible and throwing it as you would a dart. The aeroplane will make an easy and graceful flight in a room where no air will strike it.—Contributed by J. H. Crawford, Schenectady, N. Y.

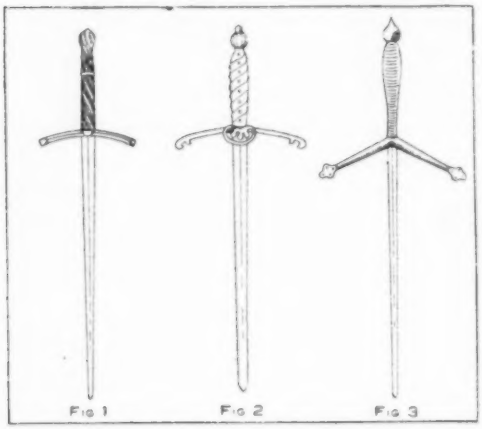


Folding the Paper

Banana oil or amyl acetate is a good bronze liquid.

Imitation Arms and Armor—Part II

Imitation swords, stilettos and battle-axes, put up as ornaments, will look well if they are arranged on a shield which is hung high up on a wall of a room or hall, says the English



Three Fifteenth Century Swords

Mechanic, London. The following described arms are authentic designs of the original articles. A German sword of the fifteenth century is shown in Fig. 1. This sword is 4 ft. long with the crossguard and blade of steel. The imitation sword is made of wood and covered with tinfoil to produce the steel color. The shape of the sword is marked out on a piece of wood that is about ⅛ in. thick with the aid of a straightedge and pencil, allowing a little extra length on which to fasten the handle. Cut the sword out with a saw and make both edges thin like a knife blade and smooth up with sandpaper. The extra length for the handle is cut about 1 in. in width and 2 in. long. The handle is next carved and a mortise cut in one end to receive the handle end of the blade. As the handle is to represent copper, the ornamentations can be built up of wire, string small rope and round-headed nails, the whole finally having a thin coat of glue worked over it with a stiff bristle brusl and finished with bronze paint.

The crossbar is flat and about 1 in. in width. Cut this out of a piece of wood and make a center hole to fit over the extra length on the blade, glue and put it in place. Fill the hole in the handle with glue and put it on the blade. When the glue is thoroughly dry, remove all the surplus with a sharp knife. Sheets of tinfoil are secured for covering the blade. Cut two strips of tinfoil, one about ½ in. wider than the blade and the other ¼ in. narrower. Quickly cover one side of the blade with a thin coat of glue and evenly lay on and press down the narrow strip of tinfoil. Stick the wider strip on the other side in the same way, allowing equal margin of tinfoil to overlap the edges of the blade. Glue the overlapping edges and press them around on the surface of the narrow strip. The crossguard must be covered in the same manner as the blade. When the whole is quite dry, wipe the blade up and down several times with light strokes using a soft rag.

The sword shown in Fig. 2 is a two-handed Swiss sword about 4 ft. in length, sharp on both edges with a handle of dark wood around which is wound spirally a heavy piece of brass or copper wire and held in place with round-headed brass nails. The blade and crossbar are in imitation steel. The projecting ornament in the center of the crossguard may be cut from heavy pasteboard and bent into shape, then glued on the blade as shown.

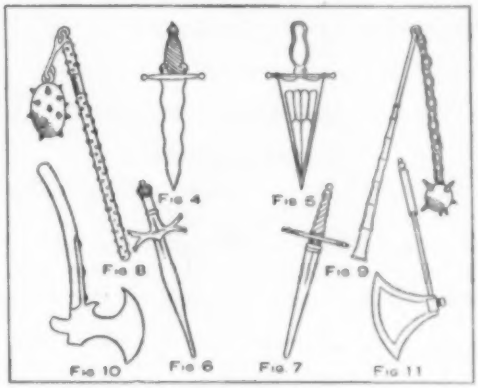
In Fig. 3 is shown a claymore, or Scottish sword of the fifteenth century. This sword is about 4 ft. long and has a wood handle bound closely around with heavy cord. The crossbar and blade are steel, with both edges sharp. A German poniard is shown in Fig. 4. This weapon is about 1 ft. long, very broad, with wire or string bound handle, sharp edges on both sides. Another poniard of the fourteenth century is shown in Fig. 5. This weapon is also about 1 ft. long with wood handle and steel embossed blade. A sixteenth century German poniard is shown in Fig. 6. The blade and ornamental

crossbar is of steel, with both edges of the blade sharp. The handle is of wood. A German stiletto, sometimes called cuirass breakers, is shown in Fig. 7. This stiletto has a wood handle, steel crossbar and blade of steel with both edges sharp.

In Fig. 8 is shown a short-handled flail, which is about 2½ ft. long with a dark handle of wood, studded with brass or steel nails. A steel band is placed around the handle near the top. The imitation of the steel band is made by gluing a piece of tinfoil on a strip of cardboard and tacking it to the handle. A large screweye is screwed into the top of the handle. The spiked ball may be made of wood or clay. Cover the ball with some pieces of linen, firmly glued on. When dry, paint it a dark brown or black. A large screweye must be inserted in this ball, the same as used on the end of the handle, and both eyes connected with a small piece of rope twisted into shape. The rope is finished by covering with tinfoil. Some short and heavy spike-headed nails are driven into the ball to give it the appearance shown in the illustration.

A Russian knout is shown in Fig. 9. The lower half of the handle is of wood, the upper part iron or steel, which can be imitated by covering a piece of wood that is properly shaped with tinfoil. The whole handle can be made of wood in one piece, the lower part painted black and the upper part covered with tinfoil. A screweye is screwed into the upper end. A length of real iron or steel chain is used to connect the handle with the ball. The ball is made as described in Fig. 8. The spikes in the ball are about 1 in. in length. These must be cut from pieces of wood, leaving a small peg at the end and in the center about the size of a No. 20 spike. The pegs are glued and inserted into holes drilled into the ball.

In Fig. 10 is shown a Sclavonic horseman's battle-axe which has a handle of wood painted dark gray or light brown; the axe is of steel. The blade is cut from a piece of ¼-in. wood with a keyhole saw. The round part is made thin and sharp on the edge. The thick hammer side of the axe is built up to the necessary thickness to cover



Ancient Weapons

the handle by gluing on pieces of wood the same thickness as used for the blade, and gradually shaping off to the middle of the axe by the use of a chisel, finishing with sandpaper and covering with tinfoil. Three large, round-headed brass or iron nails fixed into the front side of the handle will complete the axe.

At the beginning of the sixteenth century horseman's battle-axes shaped as shown in Fig. 11 were used. Both handle and axe are of steel. This axe is made similar to the one described in Fig. 10. When the woodwork is finished the handle and axe are covered with tinfoil.

How to Make a Round Belt Without Ends

A very good belt may be made by laying several strands of strong cord, such as braided fishline, together as shown in Fig. 1 and wrapping them as

Method of Forming the Belt

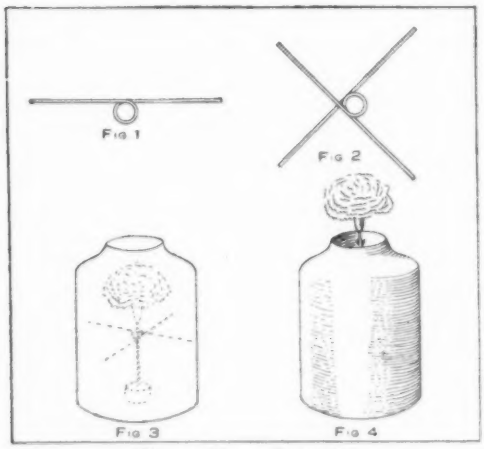
shown in Fig. 2. When wrapped all the way around, the ends are tied and cut off. This will make a very good flexible belt; will pull where other belts

slip, and as the tension members are all protected from wear, will last until the wrapping member is worn through without being weakened.—Contributed by E. W. Davis, Chicago.

Old-Time Magic—Part IX

The Growing Flower

This trick is performed with a wide-mouthed jar which is about 10 in. high. If an earthern jar of this kind is not at hand, use a glass fruit jar and cover it with black cloth or paper, so the con-



Flower Grows Instantly

tents cannot be seen. Two pieces of wire are bent as shown in Fig. 1 and put together as in Fig. 2. These wires are put in the jar, about one-third the way down from the top, with the circle centrally located. The wires can be held in place by carefully bending the ends, or using small wedges of wood.

Cut a wire shorter in length than the height of the jar and tie a rose or several flowers on one end. Put a cork in the bottom of the jar and stick the opposite end of the wire from where the flowers are tied through the circle of the two wires and into the cork. The dotted lines in Fig. 3 show the position of the wires and flowers.

To make the flowers grow in an instant, pour water into the jar at one side of the wide mouth. The cork will float and carry the wire with the flowers attached upward, causing the flowers to grow, apparently, in a few seconds' time. Do not pour in too much water to raise the flowers so far that the wire will be seen.—Contributed by A. S. Macdonald, Oakland, Calif.

Water and Wine Trick

This is an interesting trick based on the chemical properties of acids and alkalies. The materials needed are: One glass pitcher, filled with water, four glass tumblers, an acid, an alkali and some phenolphthalein solution which can be obtained from your local druggist. Before the performance, add a few drops of the phenolphthalein to the water in the pitcher and rub a small quantity of the alkali solution on the sides of two of the tumblers and repeat, only using as large a quantity of the acid as will escape notice on the remaining tumblers. Set the tumblers so you will know which is which and proceed as follows: Take hold of a prepared tumbler with the left hand and pour from the pitcher, held in the right hand, some of the liquid. The liquid turned into the glass will become red like wine. Set this full tumbler aside and take the pitcher in the left hand and pour some of the liquid in one of the tumblers containing the acid as it is held in the right hand. There will be no change in color. Repeat both parts in the same order then begin to pour the liquids contained in the tumblers back into the pitcher in the order reversed and the excess of acid will neutralize the alkali and cause it to lose its color and in the end the pitcher will contain a colorless liquid.—Contributed by Kenneth Weeks, Bridgeton, N. J.

The life of iron shingle nails is about 6 years. An iron nail cannot be used again in putting on a new roof. Solid zinc nails last forever and can be used as often as necessary. As zinc is much lighter than iron, the cost of zinc nails is only about 2½ times that of iron nails.

NEW EXPLOSIVE FOR PANAMA CANAL

A new explosive, the invention of an Englishman, has been tested on the isthmus with such results that the Panama canal commission has ordered 20 tons of it for trial as blasting charges. The tests made before the commission proved that it was impossible to set it off by any ordinary means. It was hammered with a sledge, it was burned, shot at with a rifle, and ordinary dynamite detonators were exploded in it, both by fuse and by electricity, without results. The only way it was set off was by a special detonator, a small platinum wire just inside the open end being heated by an electric spark.

The explosive is composed of perchlorate of ammonia, nitrate of soda, dinitrotototolnol and several other ingredients, such as paraffin, for waterproofing. It is said to be 50 per cent more powerful than the 66 per cent grade of dynamite, and about $20 per ton cheaper.

BICYCLE WITHOUT FORKS

This bicycle is curious because built without forks. Instead, there is a single stay or arm to keep each wheel in position, arranged on alternate sides. They give a somewhat insecure appearance to the machine, but are claimed to have sufficient strength for the purpose.

A Bicycle Curiosity

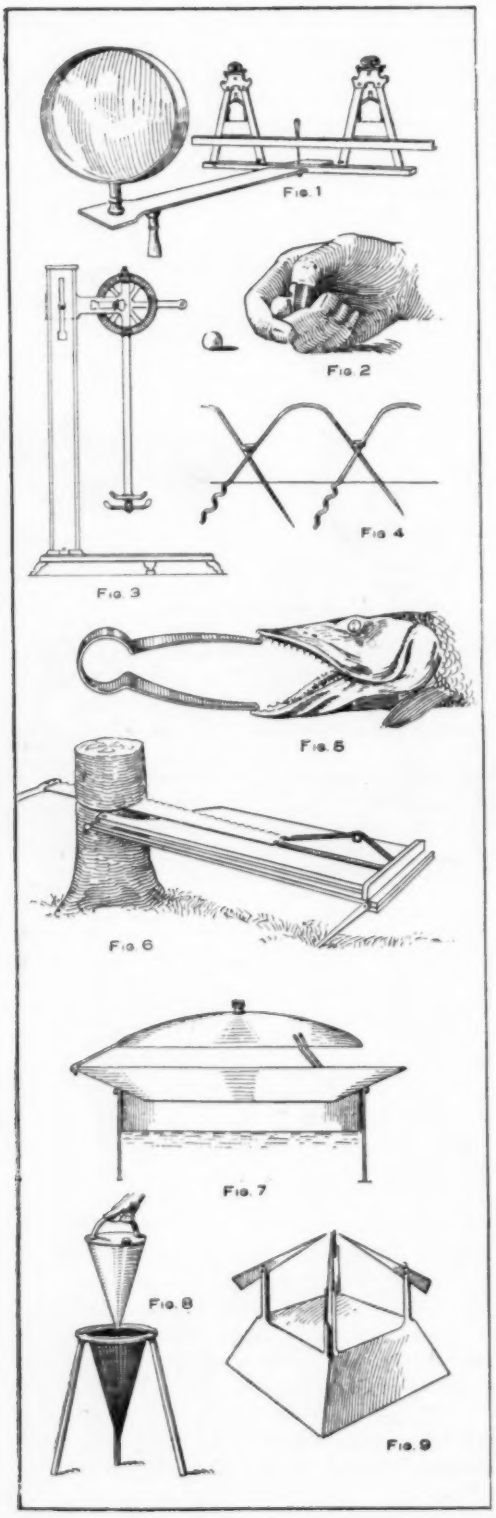
The idea is to make possible the removal of the tires without taking the wheels from the frame, should they burst or become punctured during a race or a long ride. Slipping new tires in place takes but a few seconds.

OCEAN TONNAGE OF THE WORLD

From the figures compiled by Lloyd's, the ocean tonnage amounts to 41,449,767 tons this year compared to 40,922,842 in 1908. An idea of how this is divided among the different countries is given in the table.

	1908.		1909.	
	Steamers.	Sailing ships.	Steamers.	Sailing ships.
	Tons gross.	*Tons net.*	*Tons gross.*	*Tons net.*
British	17,499,542	1,209,995	17,702,714	1,123,728
United States	3,549,461	1,305,326	3,662,332	1,291,480
German	3,839,387	392,767	3,889,046	377,667
French	1,416,987	466,907	1,445,976	447,617
Norwegian	1,351,647	631,231	1,388,423	605,201
Japanese	1,140,177	2,291	1,150,858	1,942
Italian	903,567	381,658	961,132	358,785
Dutch	841,870	34,750	901,536	37,704
Russian	755,350	219,167	760,785	211,612
Swedish	732,280	171,875	774,288	148,510
Austro-Hungarian	733,402	7,107	744,676	5,481
Spanish	677,345	23,933	686,875	23,143
Danish	660,582	73,208	677,098	65,060
Belgian	205,035	3,922	268,459	3,296
Brazilian	215,656	20,684	222,110	20,705
Turkish	112,655	53,266	112,849	61,895
Chilian	110,531	47,466	106,857	40,570
Portuguese	68,412	37,588	69,878	36,104

Comparative Ocean Tonnage of the Nations



RECENT

BANK NOTE TESTER.—A device to aid in testing bank notes is shown in Fig. 1. It is made in the same general form as the stereoscope, but the magnifying glass is of the ordinary kind, and its manner of mounting before the frame on which the bank notes to be tested are placed is simply a matter of convenience.

DEVICE AIDS MARBLE SHOOTING.—Figure 2 is a device with which to shoot marbles. It consists of a leather or fabric thimble worn on the shooting thumb, the outer edge of which, when the thumb is bent in position to shoot, has a metal face with a projecting stud.

CHURNING DEVICE.—Figure 3 is a dasher mechanism for the churning of butter. It consists of a stand, a dasher, and a hand crank for turning the dasher. It can be used with any kind of churning receptacle, the dasher and crank being arranged so that they can be raised or lowered on the supporting stand.

A POSTLESS BORDER-FENCE.—The fence illustrated in Fig. 4 is described as postless, and is presumably designed as a low border fence. Every other one of the wire units that form it has a laterally extended loop through which the intermediate units pass until loops in their free ends engage with the first mentioned loops.

A SAFETY FISH-HOLDER.—Almost any fisherman remembers instances when his fingers have been more or less scratched or bitten in trying to remove the fish hook from the mouth of his catch. The device shown in Fig. 5 protects the hands from such injury by holding the fish's mouth wide open.

AN INTERESTING DRAG-SAW.—The device shown in Fig. 6 makes possible the sawing of trees by one man. It consists of a saw, a supporting frame for one end, and a pair of coil springs. The saw-supporting frame has pivoted legs to support its outer end and its inner end is made fast to the tree to be felled. When the worker completes the drawing of the saw towards himself the springs aid him in the return stroke.

FRYING-PAN COVER.—The frying-pan cover shown in Fig. 7 effectually prevents the flying of grease from the pan, without at the same time smothering the article being cooked. It consists of a dome-shaped top provided with clips which engage with a lower section. This latter, which has no center, might be called a collar, although it sets upon the frying-pan rim instead of around it.

FRUIT PRESS AND STRAINER.—The device in Fig. 7 combines a fruit press and strainer in one. It consists of an outer conical shell of wire netting into which a closed metal cone is pressed. The pressing cone has a screw cap in its top through which weighing material may be poured. The fruit to be pressed and strained is placed in the outer cone, and the corresponding cone is pressed down upon it.

CIGAR PERFORATOR.—Cutting the end of a cigar exposes its filler and often results in the smoker finding that he has drawn some of the tobacco into his mouth. The device shown in Fig 9 perforates the cigar just above its end instead of cutting the end off. This makes it draw freely and at the same time keeps the end of the cigar intact in the mouth.

GRUBBING IMPLEMENT.—Figure 10 is an implement which makes the removal of bushes and small trees from the soil a simple task in clearing ground. It is composed of a base, an arm extending upward in a curve from the base, a jaw at the end of the arm, and a lever for closing the jaw upon the tree and for exerting the power required to tear it from the ground.

THE RICHNESS OF THE GUIANAS

PATENTS

IRONING CABINET.—The sides of the ironing-board cabinet in Fig. 11 are provided with runways and a runner by which the ironing board is swung into position for use or drawn back into its box. The cabinet also contains room for the irons and other articles required.

FOOT CONTROL FOR GRAPHOPHONES.—In many large business offices, especially those of concerns selling goods by correspondence, the persons composing the letters dictate them into graphophones. The records thus made are then placed on machines on the desks of the typewritists who take mechanical dictation from them. The graphophones are timed to suit the speed of the typewritist, but should an erasure become necessary or the graphophone outspeed him, he must stop the dictation until he catches up. To make this possible without the use of the hands the device shown in Fig. 12 has been invented. It is a foot control, pressure upon which will stop the graphophone until released.

BUTTER AND LARD CUTTER.—The butter and lard cutter shown in Fig. 13 is made in several sizes, each of which holds a certain weight, such as, for instance, a pound, or a half or quarter of a pound.

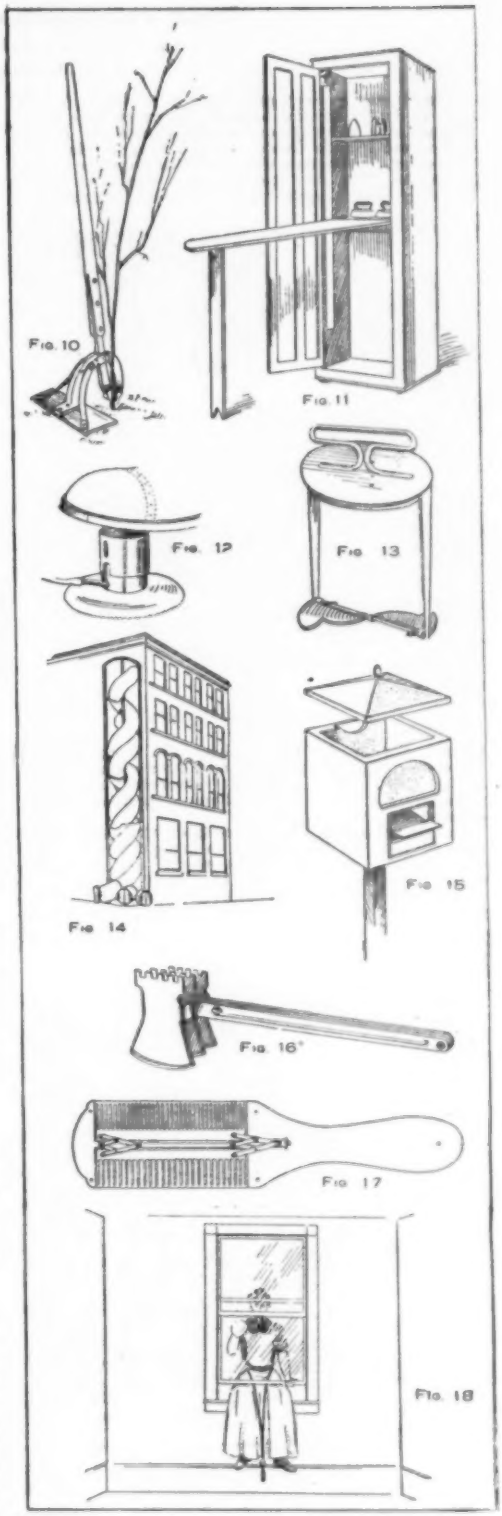
TRIPLE-TUBE FIRE-ESCAPE.—The fire escape shown in Fig. 14 differs from other tubular fire escapes in the fact that it has three spiral tubes instead of only one. The type of school building on which it would be placed would presumably have four floors, and each of the upper floors would have its own distinctive tube. The three tubes wind around each other as do the strands of a rope, and are incased in a straight tube or drum of metal.

CONCRETE BEEHIVE.—That concrete can be used for the construction of almost anything, large or small, is being continually demonstrated. Attention was recently drawn to a concrete hen's nest. This time it is a concrete beehive. The shape of the hive is shown in Fig. 15. It stands upon a concrete post, and is provided with concrete chamber for the honey trays, food receptacles, passages, and, in fact, all the requirements of a bee dwelling.

MEAT-TENDERER AND VEGETABLE-CHOPPER.—Two necessary kitchen utensils in one are shown in Fig. 16. It is a meat-tenderer and vegetable- or meat-chopper consisting of three twin blades, heads, and handles, any one of which can be used alone, or all three together as shown in the illustration. The combined heads are used for breaking and separating the fibers of meat, and the three blades for chopping purposes. The manner of combining the three parts as one is clearly shown.

COMBINATION BRUSH AND COMB.—Figure 17 is a combination brush and comb, the brushing part of which is not shown in the drawing. On the back of the brush, as is clearly seen, is a set of two combs, one of which is slightly coarser than the other. The back has a recess in which the combs rest in a flat position when not in use. Between them is a series of bars which swing them upright and hold them in position for use.

SAFETY APPLIANCE FOR WINDOW-WASHERS.—It is all very well for a male window-washer to stand outside on a window ledge and be held in position by a belt arrangement made fast by straps to the window framing, but the arrangement illustrated in Fig. 18 is much more satisfactory for women. It comprises a belt from which a retaining cable leads to a hook fastened to the baseboard beneath each window. The woman sits with her limbs inside the room and the rest of her body outside, in which position she can easily clean the outside of the glass in perfect safety.

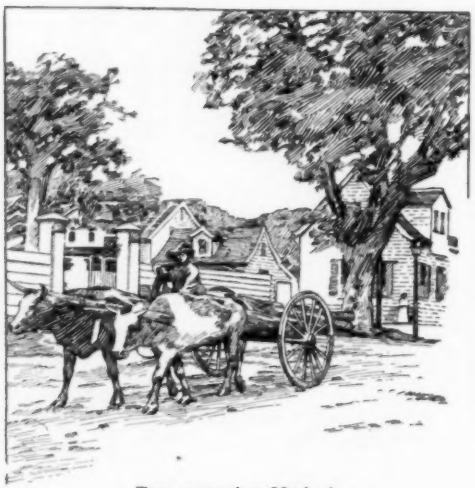


THE RICHNESS OF THE GUIANAS

Gold, Diamonds and Cotton in Abundance

By J. B. Percival, Paramaribo, D. G.

The extensive territory lying along the Atlantic coast of South America between Venezuela and Brazil, divided into three colonies and known as British, Dutch, and French Guiana, is rich in gold, diamonds, and cotton. Diamonds were first discovered in British Guiana in 1876, but no attention was paid to the discovery owing principally to the distance from



Transportation Methods

Georgetown to the place where the discovery was made, and the dangerous rapid rivers that had to be traversed. Then gold was discovered, and in the daily cleaning up of the production diamonds continually made their appearance.

In 1900 well organized expeditions were sent out to various parts of the colony to prospect, and many rich finds of diamonds were made, but as yet no systematic diamond mining has been started, principally owing to the lack of capital. Extensive prospecting in Dutch and French Guiana has also unearthed diamonds, and it is the opinion of many experts that they exist through the length and breadth of the entire country.

Type of Residence

The writer has also engaged in prospecting trips in search of gold, and believes there are extensive deposits in all three Guianas. On the River Mana, in French Guiana, he saw parties of blacks engaged in washing gold from a certain gravel deposit on a hillside, which, when investigated, proved enormously rich. Many pans were yielding as much as 2 to 2½ lb. Troy in nuggets, while all the gravel carried more or less visible gold. All the best specimens of quartz were carefully collected and transported to the camps of these natives, who stored them up against crushing day. This irksome work was performed by women, armed with small hammers. The crude crushing was done on a stone slab in the center of the camp, and when specimens proved too tough for the crushing instruments, they were discarded and thrown away as useless. In nearly every case these discarded bits were worth from $15 to $20 each. I saw specimens of quartz in other localities that seemed to carry as high as $40,000 of gold to the ton, and am not surprised that Guiana is today called the Eldorado. All that is necessary is capital to thoroughly explore and prospect.

Aside from its wealth in gold and diamonds, Dutch Guiana could be made rich in cotton, the plant growing freely there.

It will be extremely interesting to know that as far back as 1836, 1,273,569 lb. was exported to Europe and America in a single year. Since slavery was abolished, the cotton plantations were thrown out of cultivation owing to not having laborers (as every black man was his own master) to carry on the cultivation. Since then the cotton industry has dwindled away to nothing and today all that remains is the abandoned estates which can be bought very cheaply. In many cases, old ginning plants are to be found on some of these abandoned plantations. At the time to which I refer the proprietors of these cotton estates made big money and it stands recorded where many of these owners left the colony with their pockets well filled with Dutch guilders derived from this lucrative industry. It should be remembered that the prices paid at that time were not to be compared with the present high prices of today. Large profits can be expected from the investment of a modest amount in this industry. Maiden land can also be obtained from the colonial government on reasonable conditions; the cost of clearing and opening out this land could be given out by contract for a small sum; the cultivating could be carried out very reasonably by British free Indians and Javanese, who are best adapted for this kind of work. The refined article, or raw material, as the case may suggest, can be easily transported to Paramaribo (the city) by rail or water, and 10 days after shipment by the Dutch fruit steamers the cotton arrives in the New York market. These steamers leave the Colony every Saturday and the freight is very reasonable.

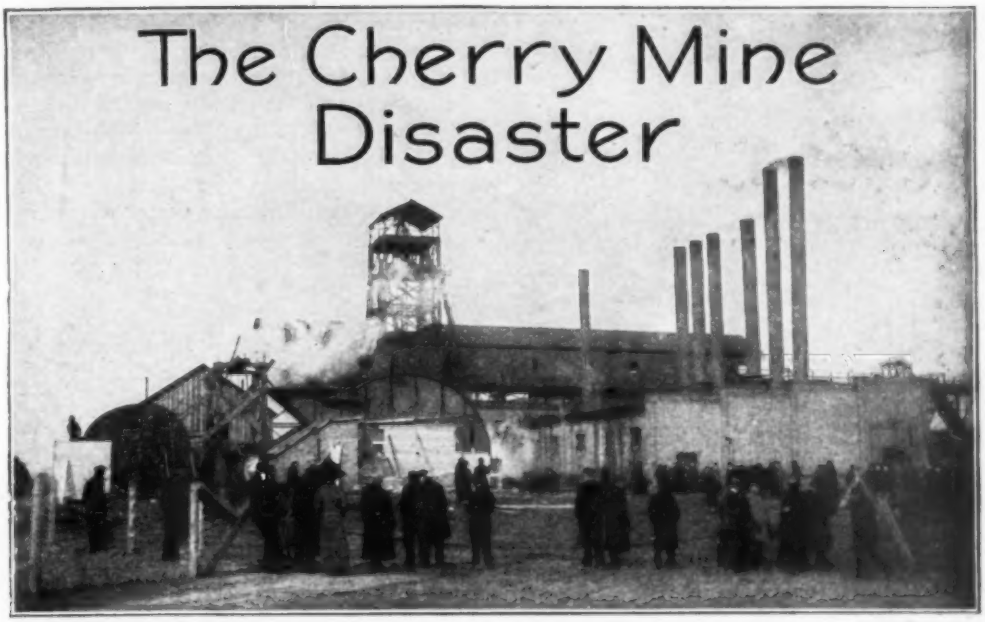
ENGLAND'S DEFICIENCY IN AERONAUTICS

Blackpool aviation week, England's greatest aeronautical exhibition yet held, proved that country to be desperate indeed, as far as home-made aviators and aeroplanes are concerned. All the prizes were won by such famous flying men as Farman, Latham, Sommers, Delagrange, Paulhan, and Rougier. The prizes for British aviators piloting British made machines, and British aviators piloting any kind of machine were not awarded.

Attempts were made to win the All-British prizes of $750 and $500 for flights of more than 100 yd., but A. V. Roe's triplane only made two hops in the air of about 20 yd., E. H. Saunderson's monoplane did not leave the ground, E. D. Crux's monoplane did not leave its shed, J. E. Neale's monoplane did not leave the enclosure, and J. Humphries' monoplane did not attempt to fly.

In the Ashley competition for British aviators, on any machine, Mortimer Singer's Voisin biplane did not leave the ground, but ran on its wheels from its shed to starting point and back to shed, a distance of about 800 yd., and George H. Parkinson's Bleriot monoplane did not leave the ground, but ran about 200 yd. on its wheels.

The Cherry Mine Disaster



What Experts Called "Model Equipment" Availed Nothing When Combination of Unfortunate Circumstances Caused Mine to Burn—Oxygen Helmets Prove Their Worth—Description of Mine

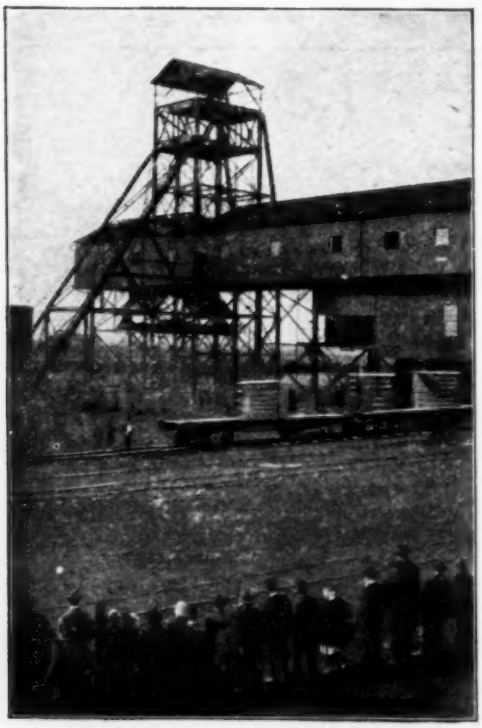
On November 13th the coal mine of the St. Paul Coal Company at Cherry, Ill., owned by the Chicago, Milwaukee & St. Paul R. R., took fire, and another great mine disaster was added to the long list.

Experts called it the safest mine in the state of Illinois, and Richard W. Newsam, chairman of the Board of State Mine Examiners, declared to a representative of this magazine that he had considered it as safe as any coal mine in the world.

Yet 290 men met their death in it, and 21 owe their lives to a remarkable rescue, made after they had existed for a week in distant galleries of the mine, where they had walled themselves in, shutting out the death-dealing smoke and gases.

The fire started near the main shaft in the roadway connecting it with the air shaft. A torch coming into contact with a load of hay, which was being drawn along the roadway toward the air shaft, through which it was to have been lowered on a temporary cage to the third level, was the origin of it. Becoming excited, the cager in charge of the load pushed the hay toward the main shaft, and dumped it into a "sump" at the bottom of the shaft in which there was a few feet of water standing. This mistake was responsible for the disaster, for the entire shaft caught fire as well as the timberings in the two levels which ran into it. When the hay was brought out into the shaft the strong draught fanned the smoldering mass into flame.

Attempts were made to put out the fire before the hay was dumped into the shaft, but, it is charged, there was not sufficient pressure in the hose at the mule stables nearby, and water could be thrown only a few feet be-



This photograph shows the superstructure of the main shaft with the water tanks brought by railroad. The crowd in the foreground is being kept back by state troops.

yond the nozzle. It has been acknowledged by officials of the mine that water was scarce above the mine. Creeping along the roadways the fire created great volumes of smoke which prevented the miners from reaching the shafts to escape.

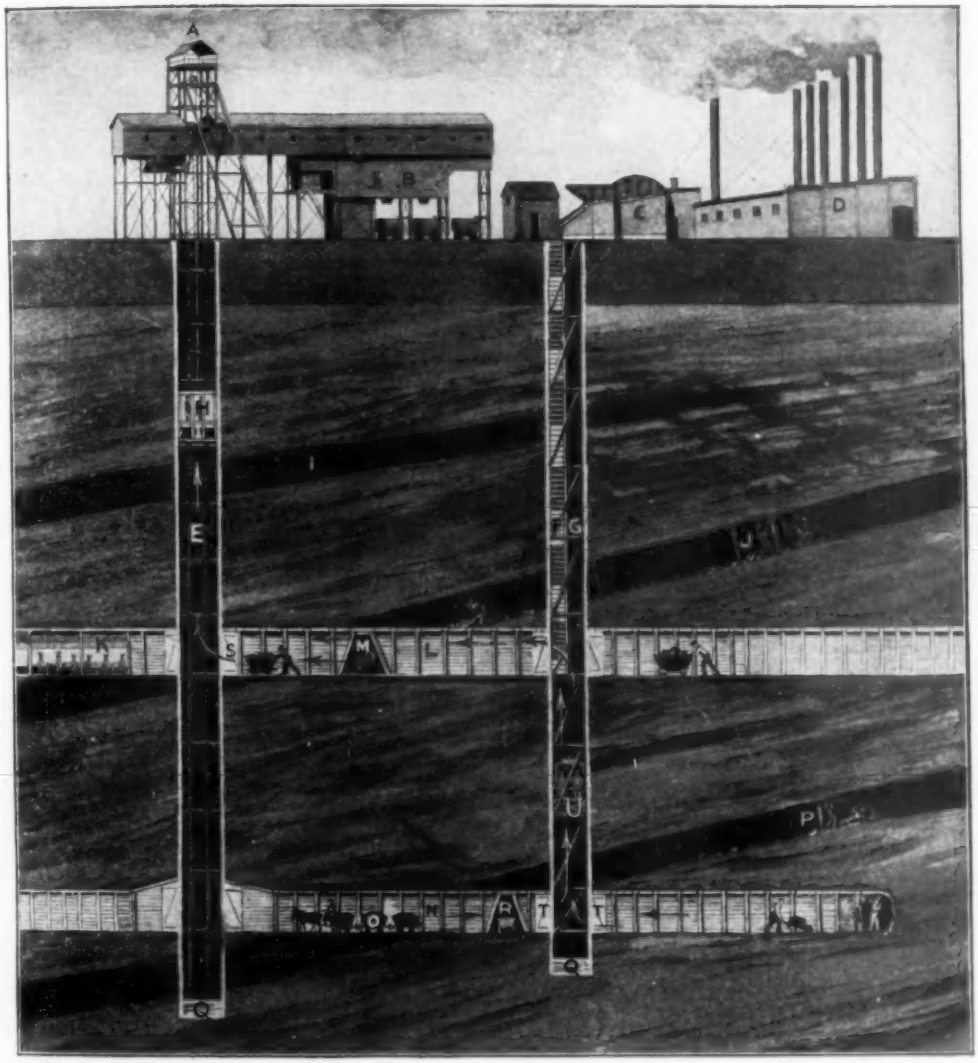
Facing death, 11 miners, among them two of the mine managers, descended into the mine in the cages, making many rescues, but they were killed as a sheet of flame swept through one of the levels and withered them.

The fire started about noon, the survivors say, but it was not until an hour later that the miners realized the full extent of their peril. At three o'clock that afternoon an attempt was made to draw the smoke from the main shaft to allow the rescuers to descend. The great steel fan, which ordinarily forces air downward to ventilate the mine, was reversed, but within a few minutes, the flames, drawn up the air shaft, put the fan out of operation, and the entombed miners were in a worse plight than ever. After vain efforts to conquer the flames by pouring tons of water into the mine from above, both shafts were temporarily sealed in an effort to smother the fire. The water had been brought from neighboring towns in huge tanks on flat cars. The sealing of the mine was done by laying canvas over every opening, and covering it with sand, cutting off the ingress of air.

Tireless efforts to enter the mine on Sunday, the day after the fire started, and Monday, were in vain, resulting only in causing fresh outbreaks of fire. Throughout Tuesday the mine was kept sealed. Experts from the government mine rescue station at Urbana, Ill., made explorations of the smoke-filled shafts and levels, enabled to live by the use of oxygen helmets.

To enter the mine for this purpose

The temporary hoisting structure erected over the escape shaft, and the "float" or cage, in which the experts explored the mine.



KEY TO MINE DIAGRAM.—A, Cage Shaft; B, Coal Chute; C, Fan House; D, Power House; E, Main Shaft; F, Escape Shaft; G, Air Shaft; H, Double Cage; I, First Seam (first level); J, Miners at Work on Seam; K, Mule Stables; L, Second Level; M, Roadway into Galleries; N, Third Level; O, Mule Trucks; P, Miners Digging Under Coal (longwall system); Q, Sump; R, Roadway into Galleries; S, Door from Shaft into Level; T, Door from Air Shaft into Roadway; U, Temporary Hoisting Cage in Air Shaft.
Arrows show course of load taken from third level to surface

the escape shaft was used, a temporary hoisting arrangement being rigged up above it. The experts descended on an improvised cage, or "float," made of heavy lumber. The sides of this "float" were fitted with stout pieces of 2-in. plank, chopped away at the ends like the runners of a sled. This permitted the easy descent of the cage where sharp corners would have caught in the wreckage of the burned stairway in the shaft.

Troops arrived on Wednesday and the same day Chicago firemen succeeded in taking a stream of water down the main shaft. Suggestions that the mine be permanently sealed as there was no hope of any of the two

hundred miners being alive were debated by the experts, but fortunately the idea was not put into operation.

Henry Smith, volunteer worker, and W. E. Williams, government expert, with their oxygen helmets. Photograph taken immediately after they returned to the surface after exploring the burning mine.

On Thursday the first body was brought to the surface by the helmet-clad workers, and all day Friday they continued to bring out bodies. On Saturday, just a week from the day the fire broke out, a group of 21 men were found alive in a far gallery of the mine where they had walled themselves in. Efforts to locate others who might be alive failed, although the work of exploration continued. It was thought that the miners might have taken refuge in one of the "overcasts" on the third level, where they could secure air, and be above the water that flooded the roadways.

The finding of over a hundred bodies in the debris on the third level dispelled this hope and a few days afterwards the shafts were sealed to smother the fire and save the mine.

The oxygen helmet which the government has been urging all mines to keep on hand for such emergencies, proved its worth. This apparatus consists of the helmet proper, not unlike a diver's helmet in appearance, and an attachment to be strapped on the back, knapsack fashion. This contains two steel cylinders of compressed oxygen, a coil for cooling the oxygen before it enters the helmet, and two cylinders containing crystallized potash. The exhalation passes through the potash, the carbonic acid gas is absorbed, and whatever oxygen remains is sent back to be used again. Breathing bags are attached to the front of the helmet, enabling the wearer to breathe with ease. A small electric battery lamp completes the outfit.

The Cherry mine was opened only four years ago, and the equipment was thoroughly modern. It has three levels or seams, the first remaining unused because of the poor quality of the coal and the thinness of the vein. The second level, which was really the first working level, is 320 ft. below the surface, and had been worked to a distance of three-quarters of a mile in either direction from the shafts. The third level is 167 ft. below the second, and had been worked only since last April. Work on this level had not proceeded more than 100 ft. from the shafts. It is a soft coal mine, and produced from 1200 to 1500 tons a day, all

The oxygen helmet, apparatus to be carried on back of wearer and headpiece.

Courtesy Chicago American

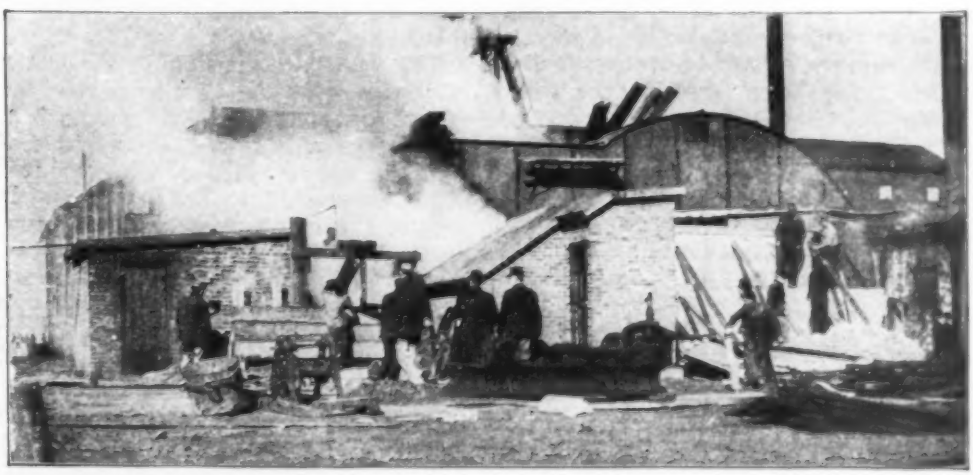
WAITING—Group of bereaved women and children standing about the shafts regardless of the bitter cold, hoping in vain for the rescue of relatives.

of which was used by the Chicago, Milwaukee and St. Paul R. R. in the operation of its lines.

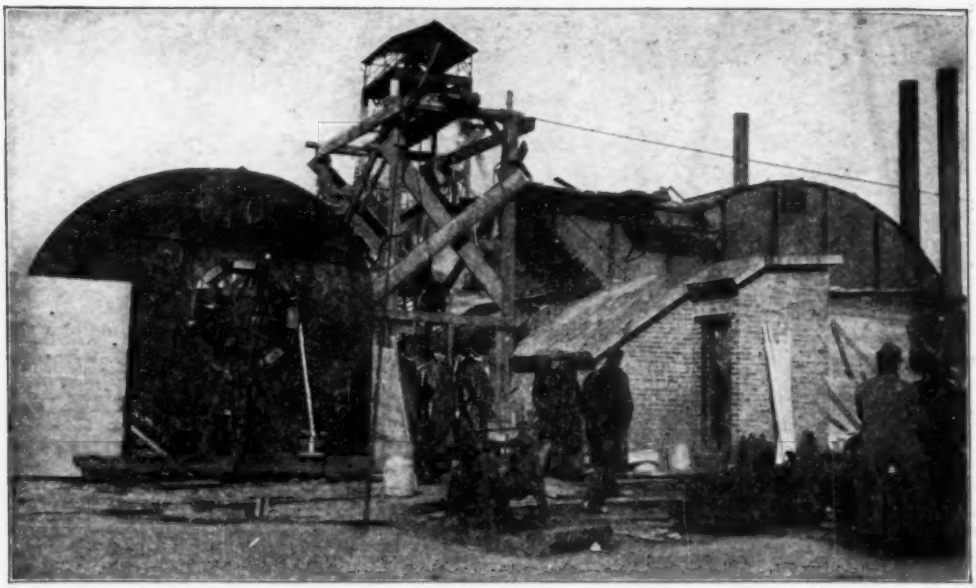
The longwall system of mining was in use. This system requires no blasting, the method being to dig under the coal and allow its own weight to break it away from the roof of the seam. The second vein was 5½ ft. thick and the third 3½ ft.

The main shaft and the combination air and escape shaft, are about 150 ft. apart, connected by wide roadways on each level. The main shaft, in which double-caged elevators operate, is 16 ft. by 12 ft., and the air and escape shaft 7 ft. 10 in., by 14 ft. 8 in.

The escape shaft was separated from the air shaft by a partition. In the former a stairway was constructed to



The wrecked fan house and workers sealing the air and escape shaft.

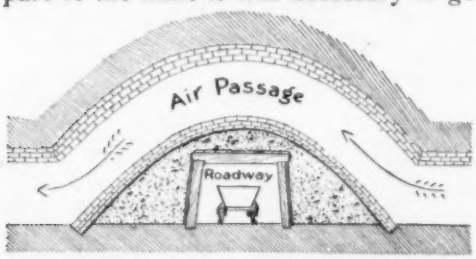


Structure erected over the escape shaft to lower temporary cage with rescuers into the mine. Temporary fan on the left

the second level consisting of short flights set at an angle of 45 degrees.

The outside equipment of the mine, that above the ground, was considered model. The tipple has three tracks, and the shaker screens, weigh hoppers, dumping cages, etc., are all of steel. The upper works at the main shaft are uninjured.

The steel double cage which operated in the main shaft did not run down to the third level. There was a temporary hoisting arrangement in the air shaft from the second level to the third, and to reach the surface from the lower part of the mine it was necessary to go



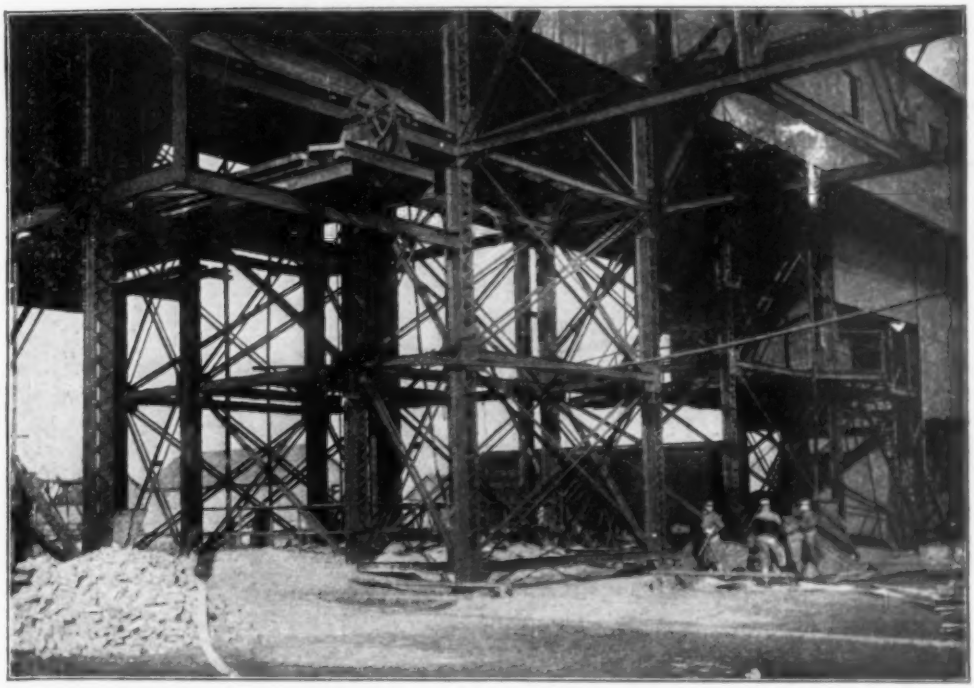
An "Overcast"—How air is guided over a roadway into galleries

up the temporary hoist in the air shaft, pass through the roadway connecting the shafts, and go up in the big cage. The recent development of the third level was responsible for this failure of the big cage to descend to the bottom of the mine.

An extensive system of fire protection had been installed, hose running from iron pipes to different parts of the mine, but there was insufficient water above the mine to fight such a fierce fire, and huge tanks had to be transported to Cherry by railroad so that the Chicago firemen could fight the flames effectively

The ventilating system in use at the mine was controlled by a huge steel fan 16 ft. in diameter and 6 ft. wide, driven by a high-speed engine and capable of forcing a quarter of a million cubic feet of air a minute into the workings. It was of the centrifugal type, air being drawn into it at the center from two inlets and then being forced downward by large concave paddles.

The escape shaft is divided from the air shaft proper by a thin iron partition. The former is 7 ft. 10 in. by 5 ft., and the latter, 7 ft. 10 in. by 9 ft. 8 in. A wooden stairway runs down the escape shaft, each flight at an angle of 45 degrees. This wooden stairway was



View showing the main shaft at top of the mine. The sand and gravel with which mine was sealed can be seen covering the opening. In the background are some of the troops guarding the shaft.

burned out when the big fan was reversed drawing the fire up.

That the steel fan itself was not injured, but the wooden doors in the fan-house which control the direction of the air, destroyed, was the statement of the designers of the fan. Steel doors are now being substituted.

The reversal of the fan does not, as the phrase would seem to imply, mean that it is stopped and operated in the opposite direction. It means that another set of air intake doors are used and the others closed.

With the exception of the wooden doors to control the direction of the air currents, the foundations of the fan house, and the structure itself, were of steel, concrete and brick.

A system of doors and stoppings was used to direct the air to the furthermost part of the workings, and out the main shaft. At intervals along the roadways doors were placed at which boys were stationed. The doors guided the currents into the side galleries, and it was the duty of the boys, "trapper boys," they are called, to open these doors to allow the mule carts to pass through. Some roadways were used for "intake" currents and others for "return" currents. Where air had to be taken and returned for some distance along one roadway, "brattice work" was used, the brattice consisting of strips of canvas nailed to posts, dividing the road in two, one side being the "intake" and the other the "return." Where it was necessary to carry a current of air beyond a roadway, at an angle, "overcasts" were used. "Overcasts" are air-crossings, passing over the roadway structure.

The entire mine was lighted by electricity, carefully insulated wires being strung along as the working face of the coal was pushed back by the miners. It was charged by some of the miners that the electric lighting plant was out of order, making the use of torches such as set the hay afire, necessary.

Aviation has been made a study in the superior, or high schools, of France.

LATEST OXYGEN GENERATING DEVICE

Can Be Carried in Pocket, Yet Generates Sufficient Oxygen for More Than Half Hour—Can Be Made for Less Than One Dollar

Only a couple of days after the Cherry disaster came the announcement by the U. S. geological survey of a new safety device, the invention of Clarence Hall, explosive expert for the government, which might have saved many lives had it been in use.

It is a simple appliance generating sufficient oxygen to prolong life for a half hour or so under any conditions of atmosphere, yet so small that it can be carried in the coat pocket, and can be manufactured for less than one dollar. It consists of a body, not unlike that of an ordinary can, to which is fitted a hood that is pressed against the face over the mouth and nose. The body is divided into two chambers, the lower of which contains sodium peroxide, while the upper contains water. When an emergency arises, the miner places the hood against his face, and turns a stop-cock, this action bringing the water in contact with the chemical and generating the oxygen. Then the oxygen passes through the water, which cools it, and thence by the hood to his nose and mouth.

The idea of such a device came to Mr. Hall while lighting the lamp of an automobile. He conceived no reason why oxygen should not be generated in the same way as acetylene gas, and the generator shown in the illustration is the result. So great an improvement is it over the oxygen helmet, which is not only very expensive, but too cumbersome for general use by other than life-saving brigades, that the geological survey is looking forward to the time when every miner working under ground will carry one in his pocket. The device, although patented, was invented while Mr. Hall was in the government service, and his chief, Dr. J. A. Holmes, insists that the patent rights shall not be enforced, but that any mining company wishing to profit by its use may acquire it without restriction.

Mr. Hall is in charge of the explosive station at Pittsburg, and has made exhaustive tests with his device in the demonstration chamber. In one test he burned excelsior until the smoke was so thick that the eye could not see through it a distance of more than four inches. He then walked into it with his invention held against his face, and remained for over 15 minutes, at the end of which time he was driven out by the smoke paining his eyes. The device, however, continued generating oxygen for more than half an hour.

Method of Using Oxygen Generator

Such a device, of course, would have to be inspected at certain intervals to ascertain whether or not the sodium peroxide had lost its strength. English scientists, however, are experimenting with a sodium peroxide tablet, which, sealed in tin-foil and torn from this casing when required, can be expected to hold its strength indefinitely.

As the result of an 80-mile gale which isolated the Grays Harbor district of Washington state for a couple of days, bicycles were in demand to accomplish many tasks made impossible by usual means because of a lack of electric power. One of these tasks was to operate the linotype machines in two newspaper plants.